

AFIT/GSS/LAS/97D-3

A PRELIMINARY STUDY OF USING THE SEI'S  
CAPABILITY MATURITY MODEL TO SET STATISTICAL  
CONTROL BOUNDS ON DOD CONTRACTOR COST AND  
SCHEDULE PERFORMANCE

THESIS

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THESIS

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## **List of Acronyms**

ACWP	Actual Cost of Work Performed
AFMC	Air Force Materiel Command
ALC	Air Logistics Center
ASC	Aeronautical Systems Center
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
CMM	Capability Maturity Model
CPI	Cost Performance Index
CPR	Cost Performance Report
C/SCSC	Cost/Schedule Control Systems Criteria
CV	Cost Variance
CWBS	Contract Work Breakdown Structure
DOD	Department of Defense
ESC	Electronic Systems Center
ROI	Return on Investment
SA-CMM	Software Acquisition - CMM
SCE	Software Capability Evaluation
SDCE	Software Development Capability Evaluation
SED	Software Engineering Division
SEI	Software Engineering Institute
SMC	Space and Missile Systems Center
SPA	Software Process Assessment
SPI	Schedule Performance Assessment
SSEB	Source Selection Evaluation Board
SV	Schedule Variance
WBS	Work Breakdown Structure

## **Abstract**

Current methods for monitoring the performance of Department of Defense (DOD) software development contractors have not been successful in reversing the current trend of over budget and behind schedule software development. The DOD has adopted the Software Engineering Institute's (SEI's) Capability Maturity Model (CMM) as a method of determining the process maturity of a software developer with the idea that a more mature process will lead to improved cost and schedule performance. The goal of this research was to determine if a model based on the CMM rating level of a contractor could be developed and used in conjunction with statistical process control to determine if contractor performance was progressing in a satisfactory manner.

To investigate this possibility descriptive statistics were applied to historical contractor performance data and a model was established. A different set of historical data was then used to evaluate the performance of the new model. This performance was then compared to the performance of current methods of statistical control.

The results obtained in this research suggest that using the CMM rating level of a contractor to set statistical control bounds is as good, and perhaps better than, the current method being employed.

# A PRELIMINARY STUDY OF USING THE SEI'S CAPABILITY MATURITY MODEL TO SET STATISTICAL CONTROL BOUNDS ON DOD CONTRACTOR COST AND SCHEDULE PERFORMANCE

## 1. Introduction

### 1.1 General Issue

Weapon systems acquired by the Department of Defense (DOD) in the late 1950's and 1960's were comprised mostly of hardware. Software played a small role, if any, in the acquisition of weapon systems. Things have changed; Brown notes that the DOD has a "deep dependence on software for virtually all its systems" (Brown, 1996:7).

"Software has become a major cost, schedule, and performance driver for virtually all DOD weapons, command and control, and information systems" (Porter, 1994). This deep reliance on software poses a dilemma for the DOD. Late and over budget software procurements are well-known as large-scale software problems (Brown, 1996:7).

Unfortunately, many previous studies have identified numerous possible solutions yet most remain unimplemented (Defense Report, 1987).

In an effort to address the problem of over-budget and late software, the DOD established the Software Engineering Institute (SEI) in 1984. SEI decided to attack the problem by focusing on the quality of the software development process. This decision was based on the process management principle which states that "the quality of a product is largely governed by the quality of the process used to build it" (Paulk, 1997:



5). SEI designed a model to measure an organization's software development process maturity. This model, the Capability Maturity Model (CMM), measures an organization's maturity by evaluating process areas key to software development. These key areas include, but are not limited to, project planning, quality assurance, product engineering, configuration management and process management (Paulk et. al., 1993).

The CMM is a framework, or road map, that an organization can follow to assess its own software capability maturity. It can also be used by an outside agency to evaluate a potential software developer's maturity. The organization maturity level is expressed by an ordinal scale from 1 (lowest) to 5 (highest) described in Table 1.1. The higher an organization's maturity level, the more likely it is to produce higher quality software.

**Table 1.1 CMM Level Description (Paulk et. al., 1993)**

<b>CMM Level</b>	<b>Description</b>
1 - Initial	The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort.
2 - Repeatable	Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
3 - Defined	The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software.
4 - Managed	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
5 - Optimizing	Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

Lloyd K. Mosemann II, former deputy assistant secretary of the Air Force for communications, computers, and logistics (SAF/AQK), believes SEI's CMM to be a step toward solving the problems plaguing the development of DOD software (Mosemann, 1992:4). By following the CMM road map, DOD procurement agents can assess a potential software developer's process maturity, and thus the likelihood of obtaining a quality software product on time and within budget. In 1996, the Airlie Council, comprised of software industry experts, identified nine commercial best practices that lead to quality software development. One of these practices is formal risk management (Basili et. al., 1997). Part of risk management is attempting to reduce the risk involved with a project. "Risk involves choice, and the uncertainty that choice itself entails (Charette, 1989: 49); so it follows that increasing predictability, and thereby reducing uncertainty, would be a step towards reducing risk and increasing the quality of a software product. Another practice recognized by the Airlie council is the use of quantitative targets, or statistical control bounds, to monitor performance. This research asserts that prediction intervals, based on the CMM rating level of a contractor, can be developed and used as control bounds for cost and schedule performance of a contractor. The key assumption is that minimum and maximum cost and schedule performance ranges can be predicted from the CMM rating level with some level of confidence, and that these intervals are reasonable control bounds for performance of a developer at a particular CMM level.

## **1.2 Specific Problem**

Recent research has established a positive correlation between CMM rating and the success of software product development in terms of cost and schedule performance (Flowe & Thordahl, 1994). It was stated in that study that a predictive model for contract performance based on CMM rating level may well be of interest to the software development community as a whole. However, little empirical research has been done to establish prediction and confidence intervals for cost and schedule performance based on CMM rating level, not because of a lack of interest, but because of a lack of available data. Case studies, involving return-on-investment, have been performed by Raytheon, Hughes, and Oklahoma City ALC, all level 2 or 3 organizations; however, these studies do not address how this return-on-investment can be used by DOD agents to predict performance. Bollinger (1991) claims that "... it appears, unlikely that such [CMM] ratings have any meaningful correlation to the actual abilities of organizations to produce ... software on time and within budget" (Bollinger & McGowan, 1991:26). Clearly, an investigation into the predictive capability of the CMM model is warranted.

## **1.3 Research Objective**

This follow-on study to Flowe & Thordahl's 1994 research is proposed to extend our ability to predict intervals for software developer cost and schedule performance based on the developer's software process maturity as determined by SEI's CMM rating level (Flowe & Thordahl, 1994:6-6). This research also proposes that an extended ability to predict performance based on CMM level can be used to statistically control the development process. Without this extension of research, the very basic notion that

unique CMM levels lead to unique levels of performance, a fundamental underpinning of theory, will remain unverified. For the purpose of this study, performance will be expressed in terms of two measures: 1) Cost Performance Index (CPI), a ratio of Budgeted Cost of Work Performed (BCWP) to Actual Cost of Work Performed (ACWP) and 2) Schedule Performance Index (SPI), a ratio of BCWP to Budgeted Cost of Work Scheduled (BCWS).

## **1.4 Scope/Limitations**

The research methodology used was chosen to yield the best opportunity of achieving the objectives of this research, within the time and resource constraints placed on it. Also, the methodology chosen was consistent with that used by Flowe & Thordahl (1994) to maintain a consistent research approach. Based on these constraints, an already existing database from the previously mentioned study was used for this effort. The database consisted of organizations that met the following criteria:

- a. Developed software for the DOD
- b. Rated in accordance with the SEI's CMM framework
- c. Tracked cost and schedule in a structured format
- d. Reported cost and schedule data to the DOD

The above constraints led to focusing on DOD contractor organizations that provided software to Air Force Program Offices at the Aeronautical Systems Center (ASC) and the Electronics Systems Center (ESC), where the necessary data was reported as part of the Cost/Schedule Control Systems Criteria (C/SCSC) contract requirements.

## **1.5 Overview**

This research is planned to establish a predictive model for cost and schedule performance derived from the SEI's CMM rating level of the developers, and then to validate this predictive model as a method to set statistical control bounds on developer performance. This is achieved by applying descriptive statistics methods to information obtained from the database comprised of contractor reported statistics to establish prediction intervals; and then comparing the performance of a contractor to these bounds, to see if the intervals accurately predict typical performance. The dependent variables used in this study are cost and schedule performance indices. Taking into account the limitations and constraints under which this research is accomplished, this study should provide a useful tool that the acquisition manager can use to monitor the cost and schedule performance of a contractor. The tool will provide early detection of unsatisfactory performance, thus reducing the cost and schedule performance risk associated with a software product procurement.

## **2. Literature Review**

### **2.1 Introduction**

Recognizing the negative trends that had emerged in the quality of software products being developed in the DOD, Lloyd K. Mosemann made the CMM the focus of a software process improvement initiative. He issued three challenges to all Air Force software development organizations: 1). Complete SEI CMM assessments by October 1, 1994, 2). Perform follow-up assessments every two years, and 3). Achieve CMM level 3 by 1998 (Coffman & Thompson, 1997). This was SAF/AQK's attempt to reverse the trends.

The first two sections of this literature review look at the software development process and current strategies to implement the process. The third section takes an in-depth look at the SEI CMM, including its applications and limitations. The fourth section reviews some current alternatives to the CMM. The fifth section introduces common performance measures. The sixth and seventh sections look at evidence suggesting the usefulness of the CMM rating level as a predictor of performance. Finally, the eighth and last section discusses the concept of statistical process control.

### **2.2 The Software Development Process**

According to Watts Humphrey, a software development process is "the set of tools, methods, and practices we use to produce a software product" (Humphrey, 1989). In short, anything that goes into converting inputs into a software product is part of the

software development process. Having a process is not sufficient to develop software; however, one needs to know how to put the resources together. That is where the software process model, or strategy, comes into play.

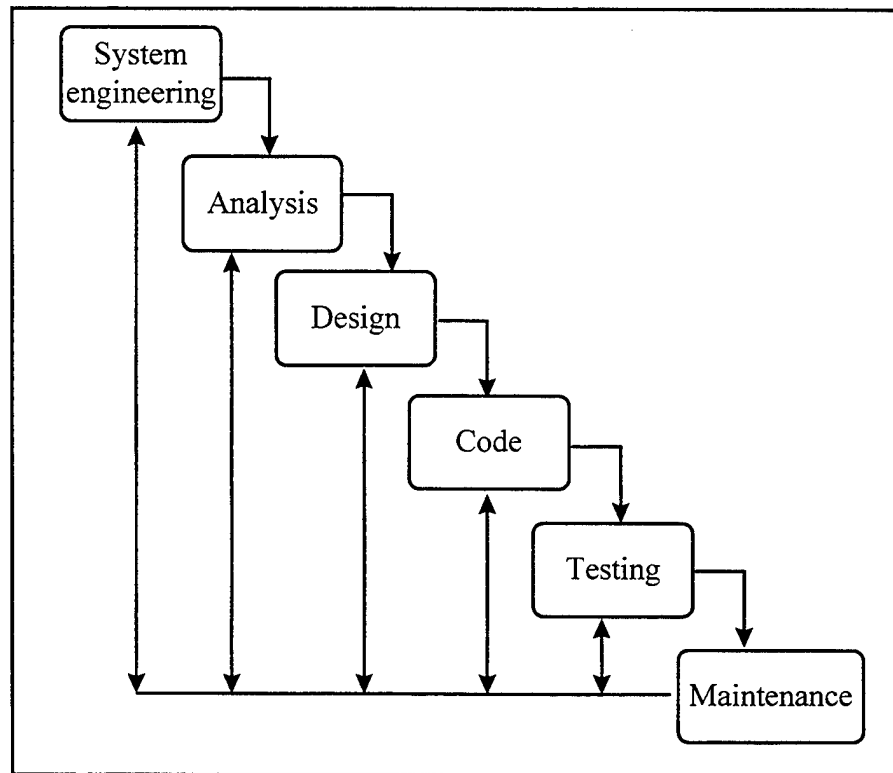
## **2.3 Program Strategies/Process Models**

As a follow-up to the software development process, several development paradigms have been popular at different times. Whereas the software development process provides the necessary building blocks to build the software, the program strategy provides a framework into which these blocks fit. Its main purpose is to determine the order of the steps involved in developing software (Boehm, 1988). It helps guide an organization, in an orderly manner, through the development process. Program strategies often address the questions of “What to do next?” and “How long shall we continue to do it?”. Several models have evolved since the earliest days, and have been popular at different times. In the next few segments, the more prominent ones will be discussed; they include Code-And-Fix, Waterfall, Prototyping, Evolutionary/Incremental, and Spiral.

### **2.3.1 Code and Fix.**

This first methodology is best described as a haphazard approach to development. Developers using this strategy jump into coding early, without fully thinking through the problem. Later, when the requirements are better understood, they go back and fix the code to reflect this understanding. The problem with this strategy is that much time is

wasted on rework. It may seem like progress is being made, but in reality the programmers are only spinning their wheels (Humphrey, 1989: 7).



**Figure 2-1 The Waterfall Model (Pressman, 1992)**

### **2.3.2 The Waterfall Model.**

Probably the most widely used and well known process model, the waterfall method, was developed in the early 1970's by Royce. This model is characterized by “a systematic, sequential approach to software development that begins at the system level and progresses through analysis, design, coding, testing and maintenance” (Pressman, 1992:24-26). Feedback is available at each of the levels of the waterfall, tying back to each of the previous levels (refer to Figure 2-1). This allows the developer to correct problems in the earlier stages, that were found later in the development process. Several



criticisms during the past ten years have raised doubt as to the applicability of this model to all situations. Some of the problems encountered are as follows: 1) Projects seldom follow a smooth sequential flow; most have some type of iteration, 2) This model requires explicit requirements statements, which are rarely available at the onset of a new development, and 3) The customer does not see a working product until very late in the project, requiring great patience and confidence on the part of the customer. Despite these very real problems, this model still has an important place in software engineering (Pressman, 1992:26).

### **2.3.3 Prototyping.**

Prototyping has become popular recently because it addresses some of the concerns dealing with the waterfall model. Prototyping is the process of developing a working model of the software project to be built (Pressman, 1992:27). Often users are not exactly sure what they want, but *they'll know it when they see it*. Prototyping allows the user to get a preview of the final product, giving them a chance to confirm their desires and solidify their requirements. Prototypes are divided into two categories, “throwaway” and “evolutionary.”

*Throwaway:* This category of prototypes is consistent with Fred Brooks’ maxim, “plan to throw one away; you will, anyhow” (Brooks, 1996). The idea is that the prototype is only a means to an end. When the requirements are solidified and the technical feasibility established, the prototype is discarded and the deliverable product is started.

*Evolutionary:* The idea behind evolutionary is to use all, or part of the prototype in the final version of the product (Gordon & Bieman, 1994). By doing this, the actual coding and other work that goes into developing the prototype is not wasted and the time and resources to develop the deliverable is less.

Some caution should be used when using the prototyping model, especially the throwaway. When a developer comes under pressure, both schedule and budget, they may be tempted to include part or all of the throwaway prototype in the final product. The problem in doing this is that the prototype was designed to be thrown away, thus the structure and the integrity of the prototype is suspect (Gordon & Bieman, 1994:93).

#### **2.3.4 Evolutionary/Incremental.**

The evolutionary model is the strategy of developing a product in successive increments. The idea behind this approach is that by developing in increments, the customer sees continual progress, while receiving a usable product earlier. Each increment of the development goes through the complete development cycle, including test. By using this approach, system integration test is effectively accomplished as the product is being developed. When the very last increment is completed, the product is finished. This approach is often combined with other models. It can incorporate the use of prototyping in developing each increment, or can be part of a spiral development.

#### **2.3.5 The Spiral Model.**

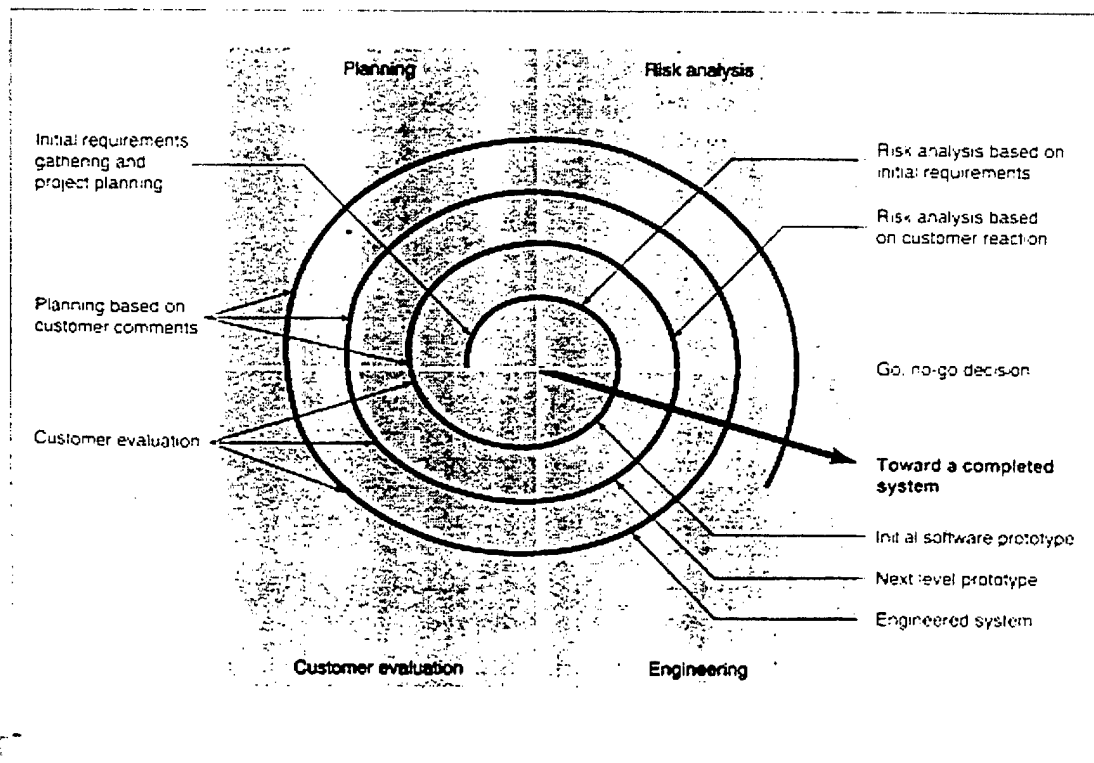
The spiral model was developed over several years in an attempt to solve some of the shortcomings of earlier models. It can accommodate most previous models as special

cases, thus retaining their benefits, and provides guidance as to which combinations of previous models best fits a given software development situation (Boehm, 1988). The spiral model takes a cyclical approach to software development. The development process starts at the innermost area of the spiral (refer to Figure 2-2) and proceeds outward along the spiral. Each time the commitment partition is crossed, a review is conducted and risks are assessed. At this point actions are to be taken to counteract any risks (Williams, 1995). According to Boehm, the primary advantage of the spiral model is that its flexibility accommodates the good features of previous models, while its risk driven approach avoids their difficulties. There are difficulties in using the spiral model, mostly due to its immaturity. These difficulties include matching the model to contract software, reliance on risk assessment expertise and a need for further elaboration of the steps of the model (Boehm, 1988).

## **2.4 The Capability Maturity Model**

The original version of the CMM was called the process maturity framework. Developed in 1987 by Watts Humphrey, the maturity framework, along with the maturity questionnaire, was intended to help the DOD identify areas where an organization's software process needed improvement (Paulk et. al., 1993: vii).

This framework later evolved into the CMM, Version 1.0 and eventually, as a result of feedback from the software community, was revised and released as Version 1.1 in 1993. This version of the CMM was intended as a foundation to improve the software process.



**Figure 2-2 The Spiral Model (Boehm, 1988)**

In order to improve one's process, one must know the current status of the process (Humphrey, 1989:3). The CMM was designed to measure the maturity of an organization's development process with the idea that increasing an organization's process maturity in stages would lead to a higher quality product (Paulk et. al., 1993:5).

As described by Paulk in his paper on the CMM, an organization with a mature process can be described as possessing an organization wide ability for managing software development. On the other hand, an organization with an immature process usually improvises during the course of development and often spends much time "fire fighting" (Paulk et. al., 1993:2).

The CMM consists of five different levels ranging from 1 (the lowest maturity) to 5 (the highest maturity). The following is a summary of the five levels from Watts Humphrey's book, Managing the Software Process:

Level 1: Labeled *initial*, a software process at this level of maturity is sometimes considered *ad hoc* or even chaotic. Usually none of the procedures are formalized, and if they are, they are not well known and often abandoned in time of crisis.

Level 2: Labeled *repeatable*, a process at this level has achieved a measure of statistical control not present at the *initial* level. This process is stable and repeatable and has rigorous project management of commitments, costs, schedules, and changes.

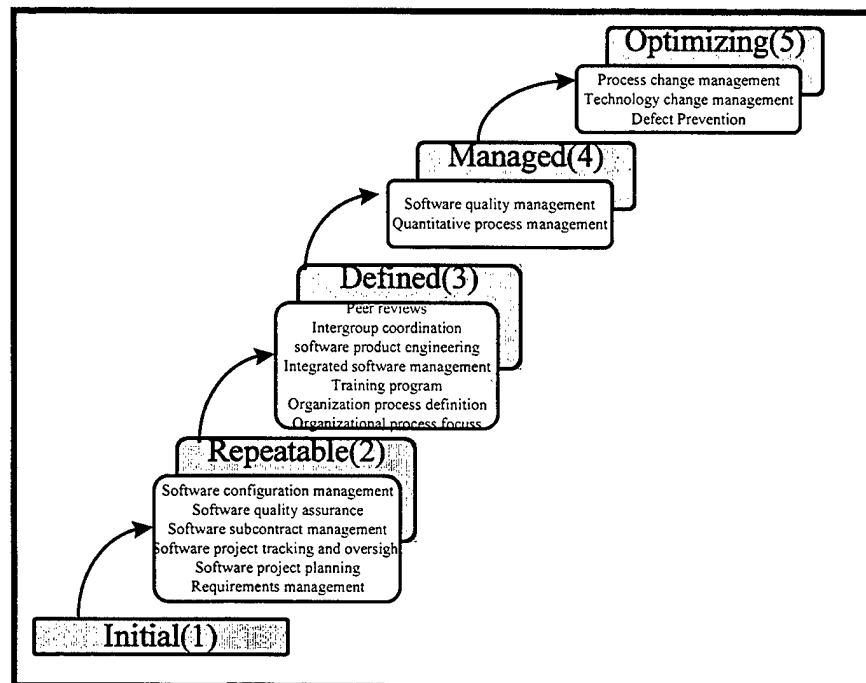
Level 3: Labeled *defined*, a process in this level is well established; it is likely to be used in times of crisis instead of discarded. The organization now has the foundation to examine the process and decide how to improve it. Advanced technology can now be introduced.

Level 4: Labeled the *managed* level, an organization at this level will have instituted a comprehensive system for obtaining and analyzing measurements. Because this measurement gathering and analyzing provides deep insight into the process, it is here that the most significant quality improvements can be made.

Level 5: Labeled *optimizing*, this is the ultimate goal of an organization. The organization at this level has such a good foundation in place that they can be proactive in fine-tuning their software development process, and in turn, improve the quality of the products.

Humphrey states that the reasons behind choosing these levels are: they reasonably represent historical evolution of improvement in real companies, they

represent an achievable measure of improvement from one level to the next, they suggest interim improvement goals and progress measures, and they make the priorities for improvement obvious once an organization's current status is known (Humphrey, 1989:5).

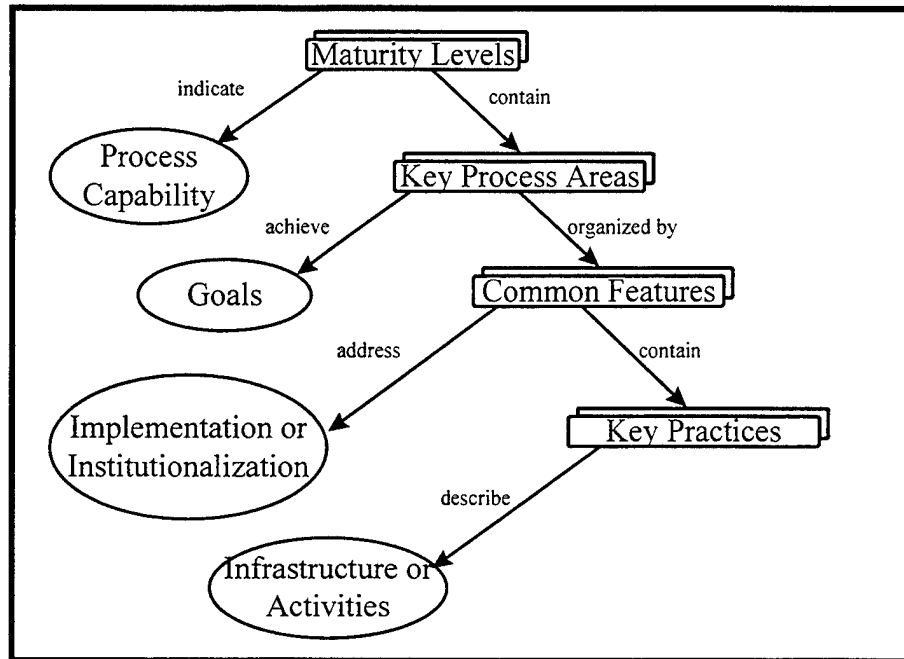


**Figure 2-3 The Key Process Areas by Maturity Level (Paulk et. al., 1993).**

### **2.4.1 Internal Structure of the CMM.**

Each CMM rating level is broken down into several key process areas, with the exception of level 1. These process areas “identify clusters of related activities that achieve a set of goals important to enhancing process capability” (Paulk et. al., 1993:30). The key process areas associated with each maturity level are shown in Figure 2-3. There are other processes besides the key processes that are involved in developing and

maintaining software; however, they have no bearing on achieving a given CMM maturity level.



**Figure 2-4 Overall CMM Structure (Paulk et. al., 1993)**

Each key process area is broken down into five common features. These common features indicate whether the implementation or institutionalization of the key process areas is “effective, repeatable, and lasting” (Paulk et. al., 1993:37). They also contain the key practices that, when addressed, accomplish the goals of the key process areas. The overall structure of the CMM can be seen in Figure 2-4.

### **2.4.2 Applications of the CMM.**

There are two main ways in which the CMM can be applied by an organization. The first is called a software process assessment (SPA) and the second is called a software capability evaluation (SCE).

The SPA focuses on the current status of an organization's software process, and identifies priorities for improvement. These assessments can be performed by a team that is either internal or external to the organization. Although these assessments can be performed by themselves, they are often done in preparation for an SCE (Bollinger & McGowan, 1991).

Whereas the SPA focuses on the current status in order to establish priorities for improvement, the SCE focuses strictly on the current capability for a given project. SCE's are performed by specially trained teams which are external to the organization being evaluated. These evaluations are often performed on bidders to a project or on existing contracts to monitor performance (Paulk et. al., 1993:44).

Both the SPA and the SCE have several commonalities. Some of these include team selection, the maturity questionnaire, analysis of the responses, site visits, and a list of team findings (Paulk et. al., 1993:45,46). As described above, however, the overall purpose of the two applications discussed is quite different.

### **2.4.3 Limitations of the CMM.**

Despite the growing popularity and acceptance of the CMM as a measure of process maturity, several concerns and limitations to the model have been expressed by industry experts.

Probably the biggest concern raised is the inability of the CMM to adequately discriminate between levels of process maturity. An organization must satisfy all key process areas of a maturity level to achieve that level (Paulk et. al., 1993). This requirement may cause a disconnect in the comparative rating of two organizations. An



organization that satisfies none of the key process areas would be considered a level 1 organization. An organization that satisfied many key process areas should clearly score higher than level 1; however, this may not be true with the CMM. For example, if a company satisfies most of the areas for level 2 and all of the areas for level 3 they would be rated a level 1 because of the areas they did not satisfy (Bollinger & McGowan, 1991:31). In this example, the company that satisfied most of the level 2 and 3 key process areas would have the same rating as that of the company that satisfied none, yet the first plainly has a more mature process in the spirit of the model.

Another concern, or limitation, is the flexibility of a company using the model. Companies that follow the CMM framework may fall victim to what is called process fossilization. Fossilization refers to a process that cannot be easily changed in any significant way (Bollinger & McGowan, 1991:39). In striving for and achieving level 5, an organization will have committed many resources and will have implemented many tools and procedures for collecting data. When a problem occurs, this data is used as a resource to determine where in the existing structure the problem exists; and fails to recognize a problem with the overall structure of the process itself (Bollinger & McGowan, 1991:39). This type of data usage results in only minor intra-process change and an inflexible overall process.

## **2.5 Alternative Means of Measuring Capability**

Because of the limitations of the CMM mentioned in the previous section, some alternative approaches to measuring an organization's software capability have been

developed. They were designed to be used to evaluate the software process instead of the CMM in situations for which the CMM is not fully appropriate or suited.

One alternative to the CMM is the Software Development Capability Evaluation (SDCE). The SDCE method was developed by ASC in 1992 and is fully described in Air Force Materiel Command (AFMC) Pamphlet 63-103. The SDCE is meant to be an integral part of the source selection process. In fact, the members of the SDCE team are also members of the Source Selection Evaluation Board (SSEB) (Babel, 1997). The overall purpose of this method is to evaluate a potential contractors capability to develop the proposed project, as opposed to the CMM which rates overall capability. The SDCE is used to identify strengths and weaknesses in specific source selection areas as well as the contractor's commitment to follow their proposed process (Babel, 1997).

A second alternative to the CMM is the Software Acquisition-CMM (SA-CMM). The CMM focuses on companies that develop software, but does not address organizations that acquire software from other companies. Recognizing a need for a model that focuses on the process of acquiring new software, the SEI developed the SA-CMM and published it in 1996. The purpose of the SA-CMM is to "describe the acquirer's or the buyer's role in software-intensive system acquisition" (Kind & Ferguson, 1997). Similar to the CMM, the SA-CMM defines five stages, or levels, of maturity for the software acquisition process. These five levels are summarized in Table 2.1. SA-CMM is intended to be used to improve the acquisition process similar to the way in which the CMM is used to improve software development processes (Kind & Ferguson, 1997). Because the SA-CMM is based on the CMM and is very similar in structure, it maintains the same limitations as the CMM.

Although this is not a conclusive list, it points out that the CMM is, by no means, the only available method of improving or evaluating the capability of a potential contractor. To this point, however, the CMM appears to be the most popular and widely known model.

**Table 2.1 The SA-CMM Maturity Level Description (Kind & Ferguson, 1997)**

<b>CMM Level</b>	<b>Description</b>
1 - Initial	The organization does not have documented processes.
2 - Repeatable	Basic acquisition management instills discipline at the project level.
3 - Defined	Acquisition organization-wide processes are defined, then tailored for each project.
4 - Quantitative	Decisions on processes and products are based on formal quantitative measures.
5 - Optimizing	Continual process and acquisition methodology improvements occur based on quantitative feedback and form piloting innovative ideas and technologies.

## **2.6 Cost and Schedule Performance Measures**

The Airlie Council, in their study of industry best practices in 1996, recognized the project control panel as both a useful tool and a concept for tracking the progress of a project, and predicting its future progress (Basili et. al., 1997). The control panel consists of several measures of performance in primary areas of a project; such as productivity, completion, change, staff, risk, and quality.

One measure of particular interest to this research effort is the Cost Performance Index (CPI). This measure shows how well a project team is meeting its budget goals. The CPI is a ratio of Budgeted Cost of Work Performed (BCWP) to Actual Cost of Work performed (ACWP), two parameters present in most Earned Value Management Systems

(EVMS's). The CPI provides a historical measure of average productivity. A CPI of 1.0 indicates a project that is exactly on target for budget. A value less than 1.0 indicates a budget overrun where a value greater than 1.0 indicates a budget underrun.

Another performance measure of interest to this study is the Schedule Performance Index (SPI). Although not present on the project control panel mentioned above, the SPI is a relative to the CPI. Where the CPI is a historical measure of cost performance, the SPI is a measure of schedule performance. The SPI is a ratio of BCWP to Budgeted Cost of Work Scheduled (BCWS), two parameters also present in most EVMS's. Like the CPI, a value of 1.0 indicates an on schedule project. A value less than 1.0 indicates a schedule overrun and a value greater than 1.0 indicates a schedule underrun.

$$CPI = BCWP/ACWP \quad (2.1)$$

$$SPI = BCWP/BCWS \quad (2.2)$$

The above two measures are not the only measures of cost and schedule performance. However, these two measures have become standard for both industry and government (Nicholas, 1990:376-389).

## **2.7 Return-On-Investment Studies**

Several companies and organizations have done return-on-investment (ROI) studies showing the economic benefits of moving up the CMM maturity scale. The studies identified the costs associated with trying to improve one's CMM rating level. They then identified and assigned dollar values to the perceived benefits, both economic and non-economic, to determine the overall ROI. Three studies of prominent

organizations at different levels are described in the further detail in the following sections.

### **2.7.1 Hughes Aircraft.**

In 1987, Hughes Aircraft employed a team from the Software Engineering Institute (SEI), at a cost of \$45,000, to perform an assessment of the Software Engineering Division (SED) of the company. The SED was rated at a level 2 (Humphrey, Snyder, and Willis; 1991:13). After receiving the recommendations from the assessment team, an action plan was devised and implemented to improve the software process. Over the course of 18 months, Hughes expended 78 man-months of effort and a total cost of \$400,000 to implement the action plan.

When the SEI performed another assessment in 1990, it found that the SED had improved to a strong level 3. In the course of improving from level 2 to 3, several benefits were realized. Hughes found that working conditions, employee morale, and project schedule and cost performance had improved. The economic value of the improvements was estimated to be about \$2 million annually (Humphrey, Snyder and Willis; 1991).

### **2.7.2 Oklahoma City ALC**

In 1990, the Oklahoma City Air Logistic Center (OC-ALC), Software Division (LAS) was rated by the SEI at a CMM level of 1. In 1993, they were again rated and had achieved a level 2. Also, in 1993, an independent study was conducted to determine the cost of process improvement and the benefits obtained. The study found that over an 8-

year period, an investment of \$1.5 million by LAS resulted in a cost savings of \$11.3 million. Other findings included a 90% reduction in defect rate, a 26% reduction in test program set (TPS) maintenance costs, and a ten fold increase in productivity (Department, 1996:7-35).

### **2.7.3 Raytheon.**

In 1988, an internal assessment of the Software Systems Lab at Raytheon, based on the CMM questionnaire, rated the lab at slightly less than level 2. Four areas were identified as needing improvement: documented practices and procedures, training, tools and methods, and metrics (Department, 1996:7-40).

In 1992, a follow-up analysis revealed that Raytheon achieved a 7.7:1 ROI( a \$4.48 million return on a \$.58 million investment). Other noted savings included a 75% reduction in rework since 1988 and a 230% increase in productivity (Department, 1996:7-41).

## **2.8 Correlation Study of the CMM and Software Development Performance**

In 1994, Robert Flowe and James Thordahl conducted a study examining the correlation between CMM rating level, and cost and schedule performance of an organization. Although based on a relatively small database, the results provide some interesting insights.

The research used CPI and SPI as measures for performance. The study also considered nine possible moderating variables when establishing correlation. The results

suggest that a positive correlation exists between CMM rating level and both the CPI and SPI. The research found that a strong correlation is present when the moderating variable of “project relevance” is high. Also, the results reveal that the correlation with SPI becomes more evident when the moderation variable of “percent complete” is taken into consideration (Flowe & Thordahl, 1994:6-2,3).

## **2.9 Summary**

The ROI studies described earlier provide insights into the economic value of moving up the CMM scale; however, they provide no useful information about how the CMM can be used by the software acquisition manager. The Flowe and Thordahl study provides evidence supporting the idea that higher CMM levels indicate better cost and schedule performance; however, the study stops short of explaining how this correlation can be beneficial to the software acquisition manager.

This research attempts to build upon the relationship between CMM and performance, described in the previously mentioned studies. It proposes a method of combining the CMM rating level with the concept of statistical process control, which was developed in the 1930's and later promoted by Edward Deming and Joseph Juran, to produce a method for the software acquisition manager to monitor and control the performance of a software development contractor (Paulk et. al., 1993).

### **3. Methodology**

#### **3.1 Overview**

Once the subject of this research, the CMM, was chosen; the research continued in four phases. The first phase was the problem definition/scope phase. During this phase, a specific problem dealing with the subject was selected. Also, the scope of the problem was defined. The second phase was the data identification/gathering phase. During this phase, the appropriate data was identified, located, and gathered. Phase three was the model development phase. During this phase, the data was analyzed and a proposed model was developed. Finally, phase four was the model validation phase. During this phase, the proposed model was validated using historical data gathered about members of the target population. The following sections describe each of the four phases in full detail.

#### **3.2 Problem Definition/Scope**

The purpose of this phase was to define a specific research problem associated with the CMM. A review of the existing research pertaining to the CMM revealed that research exploring the predictive nature of the CMM might be useful to the software acquisition community (Flowe & Thordahl, 1994). It was then necessary to define the scope of the research because of the broad nature of the problem, and the limited time and resources available to conduct the research. After further review of the existing literature,



the decision was made to focus this research on applying a predictive model, based on the CMM, to the statistical process control of DOD contractors.

### **3.3 Data Identification and Gathering**

Once the problem had been defined and the scope clearly delineated, the research moved into the data identification and gathering phase. The first step of this phase was to identify the data required to conduct this research. CMM rating level was chosen to be the independent variable. ACWP, BCWP, and BCWS were selected based on the the dependent variables of interest, CPI and SPI.

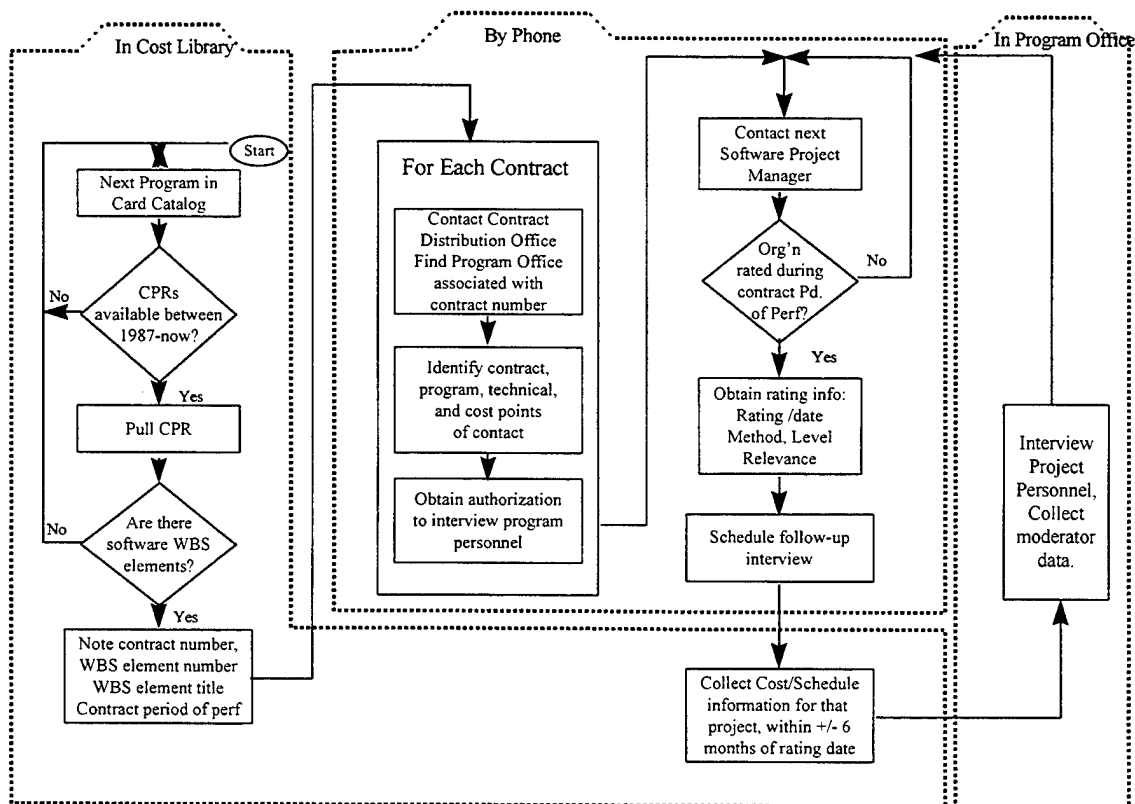
The next step was to locate reliable sources for the required data. After a search of the literature, a database containing secondary historic data from DOD software development contracts that had been established by Robert Flowe and James Thordahl for their research was located (Flowe & Thordahl, 1994). Robert Flowe was contacted and a copy of the database was obtained. The database consisted of pre-established contractor process maturity ratings (as defined by the SEI's CMM), and cost and schedule data reported to ASC and ESC in Cost Performance Reports (CPR's) as part of their contract fulfillment. The following is a summary of the steps used by Flowe and Thordahl to obtain their information (Flowe & Thordahl, 1994):

- 1) Identify appropriate contract elements: During this step, contracts that reported software development costs as a discrete contract work breakdown structure (CWBS) element were identified in the ASC and ESC libraries.
- 2) Determine rating of contractor: After identifying the appropriate contracts, it was necessary to establish whether the contractor, associated with each

contract, had been rated using the CM methodology. If not, that contract was discarded as a possible source of data; if they had, the rating information, including method used and date rating was given, was recorded.

- 3) Collection of relevant cost/schedule information: During this step, cost and schedule performance information, covering a period of six months prior to and six months following the rating date, was collected.
- 4) Collection of moderating data: Finally, other moderating data which may be used to characterize the software development project was collected to be used to gain further insight into the performance data obtained.

These steps are depicted in Figure 3-1.



**Figure 3-1 Data Gathering Flow Chart (Flowe & Thordahl, 1994)**

The reliability of the information in the Flowe and Thordahl database was considered sufficient for the purposes of this research because the collection, content, and reporting of the information are governed by the C/SCSC guidelines. Also, the same criteria for cost and schedule measurement and reporting are mandated for all contracts, making the data obtained reliable for comparison between different contracts.

An attempt was made to add to the validity of the database by adding contractor information from Space and Missile Systems Center (SMC) contracts. The person in charge of the SMC cost library was contacted, and the contents of the library was discussed. It was learned that necessary data (contractor identification) was not kept in the library. Because of this fact, contractor CMM rating level could not be ascertained and linked to the performance information, making use of the SMC cost library information for this research impractical. Because there are few, if any, reliable sources of data it was decided that the existing database would be sufficient, based on the target population of this research (DOD contractors).

Some of the data points in of the Flowe and Thordahl database had to be excluded for this research effort. Low levels of contract effort cause the variances of the indices that are more due to lack of activity than to actual variances in contractor performance. Flowe and Thordahl calculated a ratio of contract activity during the twelve month period relative to total activity to date. If this ratio showed a level of activity of less than 1% for any of the three parameters, BCWS, BCWP, and ACWP, the data point was excluded (Flowe & Thordahl, 1994). These points are identified by comments in the investigator comment box of the data forms in Appendix A.

One of the moderating variables collected by Flowe and Thordahl was rating relevance. This moderating variable rates the relevance of the project listed in the WBS to the actual CMM rating of the organization. If this variable is listed as high or very high, the project in the WBS was the project used to obtain the organization rating. In an attempt to develop a model that is as accurate as possible in relationship to the CMM rating level of the contractor, only contracts with a rating relevance of high or very high were used to develop the model.

### 3.4 Model Development

The first step of the data analysis phase, following the removal of data to be used in the validation phase (validation data selection is described in detail in the next section), was to separate the data based on CMM rating level. After separation, equations 3.1 and 3.2 were applied to the data to obtain the sample mean and standard deviation for each rating level (Devore, 1995).

$$X_{\text{bar}} = \frac{\sum_{i=1}^n x_i}{n} \quad (3.1)$$

where:  $X_{\text{bar}}$  is the sample mean.  
 $n$  is the sample size.  
 $x_i$  is a point in the sample.

$$S = \sqrt{\frac{\sum_{i=1}^n (x_i - X_{\text{bar}})^2}{n - 1}} \quad (3.2)$$

where:  $s$  is the sample standard deviation.

$n$  is the sample size.

$x_i$  is a point in the sample.

$\bar{X}_{\text{bar}}$  is the sample mean.

The next step was to calculate prediction intervals, to be used as the predictive model upper and lower statistical control bounds for performance, using equations 3.3 and 3.4. An assumption of normality must be made about the data distributions for these equations to apply to this research (Devore, 1995). The intervals calculated using these equations will be known as the model from here on out.

$$UB = \bar{X}_{\text{bar}} + t_{\frac{\alpha}{2}, n-1} \cdot s \cdot \sqrt{1 + \frac{1}{n}} \quad (3.3)$$

$$LB = \bar{X}_{\text{bar}} - t_{\frac{\alpha}{2}, n-1} \cdot s \cdot \sqrt{1 + \frac{1}{n}} \quad (3.4)$$

where: UB and LB are the prediction interval upper and lower bounds.

$\bar{X}_{\text{bar}}$  is the sample mean.

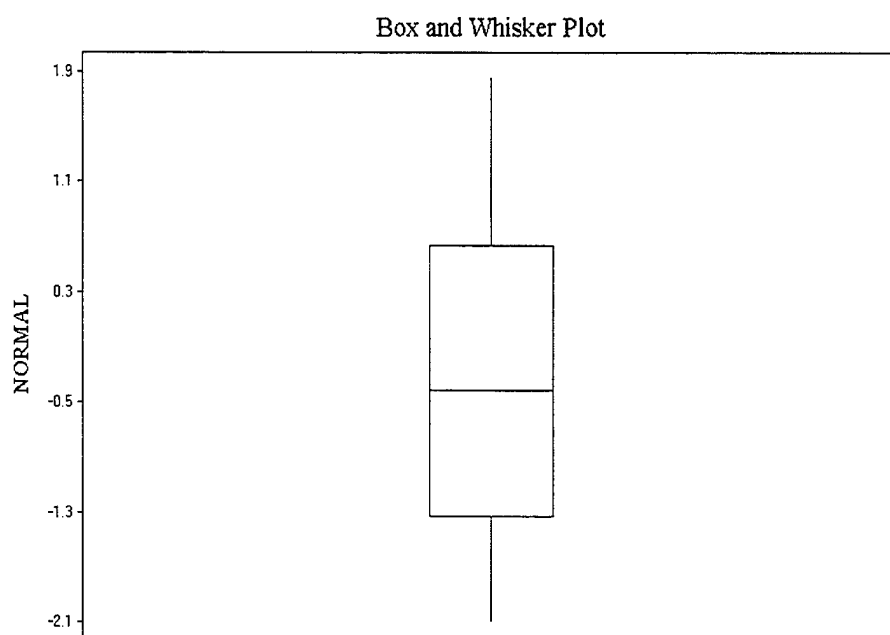
$t$  is the value of the  $t$  statistic. ( $\alpha = 1 - \text{prediction level}/100$ )

$s$  is the sample standard deviation.

$n$  is the sample size.

One graphical method of validating an assumption of normality is the box and whisker plot (refer to Figure 3-2). A box and whisker plot gives a quick graphical picture of the median of a sample distribution and the extent and nature of any departure from symmetry (Devore, 1995). It can also be used to identify any points that lie unusually far from the main body of data. This method can be used to identify sample distributions that deviate severally from normal; however, for small sample sizes the box and whisker plot may be misleading and a more precise method is required.

A more precise method of validating the normality assumption is the Wilk-Shapiro/Rankit Plot Procedure (refer to Figure 3-3). It can be used to examine whether data conform to a normal distribution or not (Analytical, 1996). This method yields a statistic equal to the square of the linear correlation between the rankits and the order statistics (Analytical, 1996). The closer to 1.00 the value is, the more normal the distribution is. For a small sample, typically less than twenty data points, a value



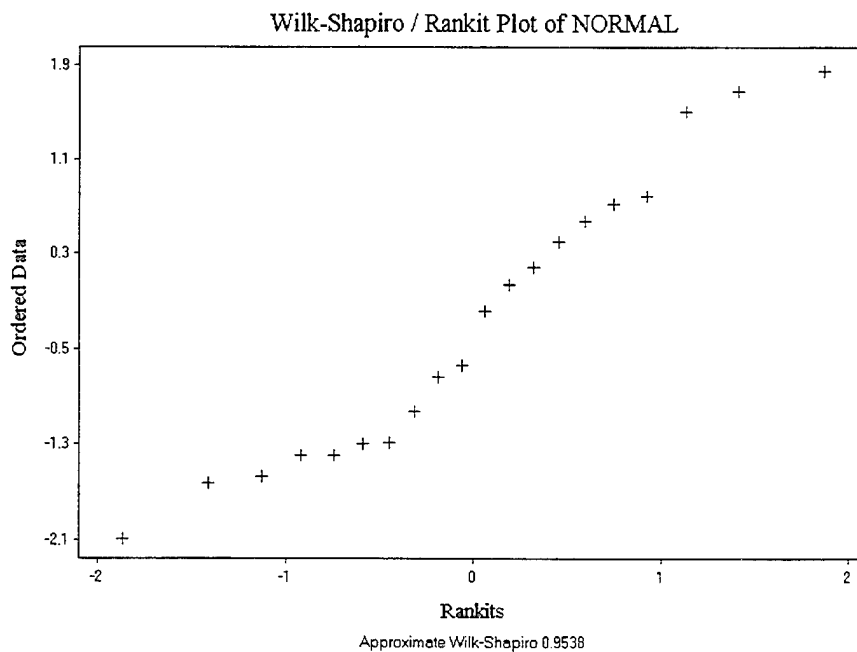
**Figure 3-2 Sample Box and Whisker Plot for a normal distribution**

of .8 or higher is sufficient for the distribution to be approximated with the normal (Reynolds, 1997).

### **3.5 Model Validation**

The research entered the model validation phase following completion of data analysis and the development of the model. The first step of this phase was to select the

data to be used for validating the model. Since the target population of this research is DOD software development contractors, it was decided to select data from contractors within this population. An available source of information was the existing database. Appropriate contractors were selected from the database based on CMM rating level and the number of data points provided by each contractor. In an attempt to obtain enough points to do the validation without reducing the database size significantly, contractors that had provided three data points were chosen. These contractors are identified by a comment in the investigator comment box of the data forms in Appendix A.



**Figure 3-3 Sample Wilks-Shapiro Plot of a Normal Distribution**

CPI and SPI were calculated for each of the points using equations 2.1 and 2.2 respectively. These values were then compared to the model value for the upper and lower control bounds to determine which points fall within the bounds and which points fall outside.

One current method of determining whether a contractor's performance is acceptable or not is to calculate the cost and schedule variance percentage of the contractor's performance and compare them against set limits. A common limit currently used by managers is  $\pm 10\%$  variance for both cost and schedule (Ferens, 1997).

In order for our proposed model to be at least as good as the current method, it was expected that any point with a variance percentage of greater than  $\pm 10\%$  would fall outside the proposed model's control bounds, and any point with a variance percentage within the  $\pm 10\%$  range would fall inside the proposed model's control bounds. The cost and schedule variance percentages were calculated for each point using equation 3.5 and 3.6 respectively.

$$\text{Cost Variance \% (CV\%)} = 100 * (\text{BCWP} - \text{ACWP}) / \text{BCWP} \quad (3.5)$$

$$\text{Schedule Variance \% (SV\%)} = 100 * (\text{BCWP} - \text{BCWS}) / \text{BCWS} \quad (3.6)$$

These variance percentages were then compared to the  $\pm 10\%$  limit and used to determine the expected position of the point with regards to the model's control bounds. Finally, any deviation from the expected position was noted.



## **4. Data Analysis/Results**

### **4.1 Model Development**

Having separated the data into two parts, the complete data set consisting of all data to be used in the development of the model, and the validation data set consisting of the data to be used in validating the model, the next step in developing the model is to validate the assumption of normality for the complete data set. The box plots of the CPI and SPI are inconclusive (see Figures B-1 and B-2 in Appendix B). There are no highly extreme values to suggest that the distributions are not normal, however, the plots are not exactly symmetrical so further analysis is needed.

Wilk-Shapiro Rankit Plots were constructed for each level of data (see Figures B-3 through B-8 in Appendix B). The Wilk-Shapiro statistics obtained from these plots are summarized in Table 4.1. The values obtained are not inconsistent with normal distributions and support the assumption of normality.

**Table 4.1 Wilk-Shapiro Statistics for SPI and CPI**

Rating Level	SPI	CPI
1	0.87	0.84
2	0.93	0.91
3	0.93	0.90

Having validated the assumption of normality, the next step is to apply descriptive statistics to the complete data set to obtain the mean and the standard deviation. These values can then be used to construct the prediction intervals necessary to develop the

model. Once again using *Statistix for windows*, the values were obtained and are summarized in Tables 4.2 and 4.3. Some of the values are contrary to the CMM theory which states that as rating level goes up, the performance of the contractor moves closer to the ideal and the variance improves. These discrepancies are addressed in the limitations section of chapter five.

**Table 4.2 Descriptive Statistics for CPI**

CMM Rating	Number in Sample	Mean	Standard Deviation
1	11	0.7326	0.2883
2	12	1.2489	0.4169
3	11	0.988	0.1104

**Table 4.3 Descriptive Statistics for SPI**

CMM Rating	Number in Sample	Mean	Standard Deviation
1	11	1.0668	0.3454
2	12	0.9741	0.0531
3	11	1.0457	0.0891

These values can now be used to construct the prediction intervals for all three rating levels and both performance indices. The prediction level used in this study is 90%. Usually a higher prediction level is preferred, but for the size of our sample a higher prediction level would yield intervals too wide to be meaningful. The  $\alpha$  corresponding to a 90% prediction level is  $1 - \text{prediction level}/100$  or .10. Dividing  $\alpha$  by two yields the required value for equations 3.3 and 3.4 which is .05. The t-statistic for this value,  $t_{.05, n-1}$  can be obtained from a standard table such as the one in Devore (Devore, 1995: 707). Substituting into equations 3.3 and 3.4 yields the intervals displayed in Table

4.4 and 4.5. Once again, one of the results is not consistent with CMM theory and is addressed in chapter five.

**Table 4.4 CPI Portion of Proposed Model**

CMM Rating	n	$t_{.05,n-1}$	Lower Bound	Upper bound
1	11	1.812	0.186971	1.278229
2	12	1.796	0.469574	2.028226
3	11	1.812	0.77906	1.19694

**Table 4.5 SPI Portion of Proposed Model**

CMM Rating	n	$t_{.05,n-1}$	Lower Bound	Upper bound
1	11	1.812	0.413106	1.720494
2	12	1.796	0.874838	1.073362
3	11	1.812	0.877072	1.214328

The intervals in Table 4.4 and 4.5 constitute the proposed model. This model is proposed to be used by acquisition managers to predict performance or monitor performance of a contractor, based on the contractors CMM level. A performance value inside the interval for a given rating level denotes acceptable, or typical, performance for that level. A value outside the interval depicts unacceptable, or atypical, performance.

## **4.2 Model Validation**

The first step in the model validation process is to compare the performance values for the selected data validation points to the model interval bounds developed

during the model development phase and note whether the value is inside the interval or not. A summary of the results of this comparison is located in Table 4.6.

The second step in the model validation process is to calculate the CV% and the SV% using equation 3.5 and 3.6 respectively, and compare these percentages to the standard limits of  $\pm 10\%$ . The location of the percentages (inside or outside the limits) is then noted. A summary of the results of this comparison are located in Table 4.7.

**Table 4.6 Comparison of CPI and SPI to Model Bounds**

<b>Contractor Code(Append A)</b>	<b>WBS Element</b>	<b>CMM Rating</b>	<b>SPI Value</b>	<b>CPI Value</b>	<b>Inside model SPI range?</b>	<b>Inside model CPI range?</b>
<b>IC</b>	1	1	1.00	0.87	yes	yes
	2	1	1.04	0.56	yes	yes
	3	1	1.01	0.84	yes	yes
<b>FA</b>	1	2	0.97	0.39	yes	no
<b>GB</b>	1	2	1.08	0.35	no	no
<b>HA</b>	1	2	1.05	0.84	yes	yes
<b>JB</b>	1	3	0.90	1.07	yes	yes
	2	3	1.29	1.98	no	no
	3	3	1.31	2.16	no	no

**Table 4.7 Comparison of CPI and SPI variance % to  $\pm 10\%$  limits**

<b>Contractor Code(Append A)</b>	<b>WBS Element</b>	<b>CMM Rating</b>	<b>SPI var %</b>	<b>CPI var %</b>	<b>Inside 10% SPI limit?</b>	<b>Inside 10% CPI limit?</b>
<b>IC</b>	1	1	0.00	-12.90	yes	no
	2	1	4.09	-58.86	yes	no
	3	1	1.30	-20.98	yes	no
<b>FA</b>	1	2	3.25	-53.86	yes	no
<b>GB</b>	1	2	7.72	-175.51	yes	no
<b>HA</b>	1	2	5.66	-12.88	yes	no
<b>JB</b>	1	3	-10.04	8.69	no	yes
	2	3	29.16	40.09	no	no
	3	3	30.69	54.69	no	no

The final step in the validation process is to compare the results in Table 4.7 to the results in Table 4.6. Table 4.8 summarizes the comparison between the 10% limit method and the proposed model method. A “yes” value indicates values lying inside the limits for the respective methods and a “no” value indicates values lying outside the limits for the respective methods. A disagreement is defined as a difference between the value in the 10% column and the value in the Model column. For the SPI performance measure, one CMM rating level 2 point disagreed and one CMM rating level 3 point disagreed. For the CPI measure, all three CMM level 1 points were in disagreement and one CMM level 2 point. The shaded areas in the table represent these disagreements between the 10% method and the model method.

**Table 4.8 Comparison of 10% Method to Model Method**

Contractor	WBS	Rating	SPI for 10%	SPI for Model	CPI for 10%	CPI for Model
IC	1	1	yes	yes	no	yes
	2	1	yes	yes	no	yes
	3	1	yes	yes	no	yes
FA	1	2	yes	yes	no	no
GB	1	2	yes	no	no	no
HA	1	2	yes	yes	no	yes
JB	1	3	no	yes	yes	yes
	2	3	no	no	no	no
	3	3	no	no	no	no

### 4.3 Analysis of Differences

There are several possible explanations for the differences noticed between the predicted values obtained using the current practice of using  $\pm 10\%$  variance as bounds

and the values obtained using the proposed model. The following paragraphs will give some of the more probable explanations.

For the SPI performance measure, two of the nine points disagreed. Both of these points disagreed at the second decimal point level. The number of decimal places reported in the model intervals and also the variance calculations are more a result of the programs used to calculate them, (Microsoft Excel<sup>®</sup> and Statistix<sup>®</sup>), than an indication of significance. For this reason it is possible that in reality there is agreement between the model and the current method being used.

For the CPI performance measure, all three of the CMM level 1 points disagreed and one CMM level 2 point. The current method assumes that all contractors should be capable of performing within the 10% limits, it does not take into account the differing maturity levels of the organization. According to the CMM, level 1 organizations are ad hoc and have a high variance (Paulk et. al., 1993). Because of this, the model intervals for CMM level 1 contractors are extremely wide, causing points that are outside the 10% limits to still be within the acceptable performance levels for a typical CMM level 1 organization. Another possible explanation is due to the sample size for the model development. The sample is relatively small in this preliminary study causing the t-statistic to be rather large. This will cause the intervals to be wide and might explain why the model says that the contractors performance is acceptable, where as the current method says it is not. Finally, a possible explanation for the CMM level 2 point is that the model has a prediction level of 90%, meaning that it is possible for contractors whose

performance is unacceptable, to fall in the acceptable range of the model 1 out of every 10 measurements.

## **5. Conclusions/Recommendations**

### **5.1 Overview**

The first goal of this research was to establish a model, based on the CMM rating level of DOD contractors, to be used for the monitoring of contractor performance in developing software. The second goal of this research was to determine the usefulness of the above model to the acquisition manager in monitoring performance of contractors on software development contracts.

Often acquisition managers use performance measures for contractors in different ways. One way in which they are used is to indicate when performance is below a set standard, such as the arbitrary  $\pm 10\%$  limit used in this study. This limit may change depending on the importance or suspected risk of a project. A project that is very important or vital to an organization may impose a limit of  $\pm 5\%$ . A project that is less important might relax the limit to  $\pm 15\%$ . The results of this study suggest that such a model might be useful in predicting or monitoring performance of a software development contractor when the acquisition manager wants to know if the contractor is performing up to its capability. This model can be used in conjunction with the practice of setting variance limits on the contractor, to fulfill multiple monitoring and controlling functions. In the following paragraphs, the implications of this research will be explored.



## 5.2 Implications for the Acquisition Manager

The theory behind the CMM suggests that the rating level of a contractor can be used as some indication of the performance capability of that contractor. The results suggest that the proposed model in this study might prove to be a useful tool to the acquisition manager. Based on the model results, performance can be predicted, given a contractors CMM rating level. Also, the model can be used to determine if the performance of a contractor is typical of an organization with the same rating level. However, the model does not perform equally well at all levels. For organizations at CMM level 1, the performance of the model is not good. It appears that because CMM level 1 organization performance has such a high variance, the interval in the model does not do a good job discriminating between acceptable and unacceptable performance. Almost any performance is considered acceptable. This is important to the acquisition manager because almost 70% of organizations are still at CMM level 1. As the rating level reaches the higher CMM levels, 2 and 3, the model discriminates as well as the arbitrary  $\pm 10\%$  limit method. Although this study did not contain any data for the higher levels of the CMM, the results suggest that the model might discriminate at a level even higher than  $\pm 10\%$ . As more and more companies move up the CMM rating scale, the usefulness of the proposed model should increase. The results are interesting and suggest that further research is warranted to determine the full usefulness of a model such as the one developed in this study.

### **5.3 Implications for the Researcher**

CMM theory is grounded in the premise that as CMM rating level increases, performance also increases and becomes more predictable. Correlation studies have supported the performance aspect of this premise. A natural extension to this premise is that, given data for organizations at the different levels, a model can be developed which could be used to predict performance at each level. The results of this study support this extension for the higher levels, 2 and 3, of the CMM. However, it is interesting that the intervals with a meaningful level of prediction, for CMM level 1 organizations, are so wide that no accurate prediction could be made with them. This may be due to the limitations of this research, but these intervals suggest that perhaps the variance of organizations at CMM level 1 is so large that meaningful prediction of these organizations is not possible. Further research into this area is needed to determine the predictive ability of such a model for CMM level 1 organizations.

### **5.4 Limitations of the Research**

There are two major areas of limitations to the applicability of this research. The first of these areas is bias in the database, the second is the content of the database itself. The following paragraphs will describe in more detail these limitations.

The database used in this research consists of second hand historical data collected by a third party. Because of this, it inherently contains bias. The method of reporting used by the contractors was controlled by guidelines (C/SCSC), which helped to reduce the level of bias introduced. The person who collected the data and constructed the database was contacted and questioned as to the thought processes and procedures

used in constructing the database. This was done in attempt to identify and reduce any bias that may be present. Unfortunately, it is impossible to eliminate the bias completely or to fully understand the nature of the remaining bias. For the above reason, the amount of bias present and the effects caused by its presence are unknown.

There are several limitations of the content of the database itself. The first of these is breadth. Data for the database was collected from DOD contractors who had reported data to ASC and ESC as part of their contracts. ASC and ESC contractors do not represent the full range of contractors providing software to the DOD. Information from contractors performing work for SMC would greatly add to the breadth of the database, but unfortunately SMC does not maintain the information in a format compatible for use in the database. Another limitation of the database is size. Even if the content of the database sufficiently covered the full range of contractors, it would still contain only a small sample. The small number of data points available for model development and model validation affected the sensitivity of the samples when data was removed for use in model validation. This sensitivity might have caused of some values obtained to deviate from theoretical expectations. The value for means and the width of the prediction intervals in the model may have been affected. A much larger database would allow the development of a more accurate model and possibly more useful model.

## **5.5 Recommendations**

There are several areas of opportunities for further research based on some of the limitations and the results of this research. Recommendations for further research are described in the following paragraphs.

One recommendation is to broaden the database and revise the model. There are several ways in which the database can be broadened that would lend to a more accurate and useful model. The first of these is to add data for contractors with level 4 and level 5 maturity ratings. At the time the database was constructed there were very few contractors at these higher levels. Although there are still not many, there may be enough to develop a preliminary model at these levels. A second area in which the database can be broadened is the addition of space systems. At this time the SMC database is not in a format that could be used for this research. Collection of relevant information on SMC contractors would extend the range of the database and add to its validity. Finally, more data points could be added at the lower levels. This preliminary study had a small sample set from which to develop the model. Additional data at the lower levels would help in developing a more accurate and possibly more useful model.

Another recommendation for further research is to revalidate the new model with a different set of data. There are two ways in which this could be accomplished. The first way is to validate the model with more points from a single contract. In this study the model was validated using a single point from different contracts. Although this was sufficient for this preliminary study, validation of the model using multiple points from a single project might be of value in determining the usefulness of the model over time. The second way to accomplish revalidation is to attempt to revalidate using a much larger sample size at each of the rating levels. For this preliminary study only three data points were used at each of the first three CMM rating levels. Increasing the number of points used would allow the researcher to validate the prediction level proposed for the model while validating its usefulness to the acquisition manager.

## **5.6 Conclusion**

The goal of this preliminary study was to evaluate the possibility of creating a model based on the CMM rating level of contractors and to determine the usefulness of such a model to the acquisition manager. The results of this study suggest that such a model might be possible and useful as a tool to monitor and control contractor performance, and that further research in this area is warranted.

## **Appendix A: Unreduced Data Set**

This appendix provides the unreduced data set contained in a Microsoft Access version 2.0 database. Each database record representing an individual data point is presented in a “form” format, with each record represented by a separate page.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="1/30/94"/>	Date: <input type="text" value="4/30/94"/>
BCWS: <input type="text" value="3110"/>	BCWS: <input type="text" value="3612"/>	BCWS: <input type="text" value="4427"/>	BCWS: <input type="text" value="4635"/>
BCWP: <input type="text" value="2715"/>	BCWP: <input type="text" value="3139"/>	BCWP: <input type="text" value="4040"/>	BCWP: <input type="text" value="4797"/>
ACWP: <input type="text" value="4095"/>	ACWP: <input type="text" value="5313"/>	ACWP: <input type="text" value="5827"/>	ACWP: <input type="text" value="7681"/>
Budget: <input type="text" value="16782"/>	Budget: <input type="text" value="16782"/>	Budget: <input type="text" value="16633"/>	Budget: <input type="text" value="16608"/>
LRE: <input type="text" value="16031"/>	LRE: <input type="text" value="16168"/>	LRE: <input type="text" value="15541"/>	LRE: <input type="text" value="16698"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="1/30/94"/>	Date: <input type="text" value="4/30/94"/>
BCWS: <input type="text" value="191"/>	BCWS: <input type="text" value="365"/>	BCWS: <input type="text" value="318"/>	BCWS: <input type="text" value="365"/>
BCWP: <input type="text" value="155"/>	BCWP: <input type="text" value="239"/>	BCWP: <input type="text" value="320"/>	BCWP: <input type="text" value="367"/>
ACWP: <input type="text" value="101"/>	ACWP: <input type="text" value="160"/>	ACWP: <input type="text" value="186"/>	ACWP: <input type="text" value="225"/>
Budget: <input type="text" value="5902"/>	Budget: <input type="text" value="5902"/>	Budget: <input type="text" value="5865"/>	Budget: <input type="text" value="5186"/>
LRE: <input type="text" value="6231"/>	LRE: <input type="text" value="6281"/>	LRE: <input type="text" value="5644"/>	LRE: <input type="text" value="5564"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☒Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="1/30/94"/>	Date: <input type="text" value="4/30/94"/>
BCWS: <input type="text" value="1500"/>	BCWS: <input type="text" value="1881"/>	BCWS: <input type="text" value="2428"/>	BCWS: <input type="text" value="2778"/>
BCWP: <input type="text" value="1224"/>	BCWP: <input type="text" value="1764"/>	BCWP: <input type="text" value="2269"/>	BCWP: <input type="text" value="2776"/>
ACWP: <input type="text" value="1427"/>	ACWP: <input type="text" value="1763"/>	ACWP: <input type="text" value="2244"/>	ACWP: <input type="text" value="2674"/>
Budget: <input type="text" value="5355"/>	Budget: <input type="text" value="5355"/>	Budget: <input type="text" value="5320"/>	Budget: <input type="text" value="4201"/>
LRE: <input type="text" value="5140"/>	LRE: <input type="text" value="5143"/>	LRE: <input type="text" value="4820"/>	LRE: <input type="text" value="4066"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="3/30/94"/>	Date: <input type="text" value="7/30/94"/>
BCWS: <input type="text" value="2807"/>	BCWS: <input type="text" value="3016"/>	BCWS: <input type="text" value="3524"/>	BCWS: <input type="text" value="3823"/>
BCWP: <input type="text" value="2794"/>	BCWP: <input type="text" value="2985"/>	BCWP: <input type="text" value="3349"/>	BCWP: <input type="text" value="3763"/>
ACWP: <input type="text" value="2829"/>	ACWP: <input type="text" value="2959"/>	ACWP: <input type="text" value="3353"/>	ACWP: <input type="text" value="3765"/>
Budget: <input type="text" value="2807"/>	Budget: <input type="text" value="4019"/>	Budget: <input type="text" value="4007"/>	Budget: <input type="text" value="4300"/>
LRE: <input type="text" value="2829"/>	LRE: <input type="text" value="4049"/>	LRE: <input type="text" value="4044"/>	LRE: <input type="text" value="4305"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☒Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: .

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="3/30/94"/>	Date: <input type="text" value="7/30/94"/>
BCWS: <input type="text" value="2517"/>	BCWS: <input type="text" value="2688"/>	BCWS: <input type="text" value="3048"/>	BCWS: <input type="text" value="3302"/>
BCWP: <input type="text" value="2496"/>	BCWP: <input type="text" value="2739"/>	BCWP: <input type="text" value="3028"/>	BCWP: <input type="text" value="3300"/>
ACWP: <input type="text" value="2568"/>	ACWP: <input type="text" value="2855"/>	ACWP: <input type="text" value="3119"/>	ACWP: <input type="text" value="3292"/>
Budget: <input type="text" value="2534"/>	Budget: <input type="text" value="3077"/>	Budget: <input type="text" value="3078"/>	Budget: <input type="text" value="3341"/>
LRE: <input type="text" value="2597"/>	LRE: <input type="text" value="3146"/>	LRE: <input type="text" value="3214"/>	LRE: <input type="text" value="3365"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments: .

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="3/30/94"/>	Date: <input type="text" value="7/30/94"/>
BCWS: <input type="text" value="2039"/>	BCWS: <input type="text" value="2151"/>	BCWS: <input type="text" value="2194"/>	BCWS: <input type="text" value="2315"/>
BCWP: <input type="text" value="2036"/>	BCWP: <input type="text" value="2129"/>	BCWP: <input type="text" value="2183"/>	BCWP: <input type="text" value="2314"/>
ACWP: <input type="text" value="2075"/>	ACWP: <input type="text" value="2176"/>	ACWP: <input type="text" value="2276"/>	ACWP: <input type="text" value="2337"/>
Budget: <input type="text" value="2043"/>	Budget: <input type="text" value="2203"/>	Budget: <input type="text" value="2203"/>	Budget: <input type="text" value="2365"/>
LRE: <input type="text" value="2082"/>	LRE: <input type="text" value="2250"/>	LRE: <input type="text" value="2295"/>	LRE: <input type="text" value="2391"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="3/30/94"/>	Date: <input type="text" value="7/30/94"/>
BCWS: <input type="text" value="1656"/>	BCWS: <input type="text" value="1317"/>	BCWS: <input type="text" value="1442"/>	BCWS: <input type="text" value="1972"/>
BCWP: <input type="text" value="1660"/>	BCWP: <input type="text" value="1317"/>	BCWP: <input type="text" value="1431"/>	BCWP: <input type="text" value="1955"/>
ACWP: <input type="text" value="1670"/>	ACWP: <input type="text" value="1321"/>	ACWP: <input type="text" value="1418"/>	ACWP: <input type="text" value="1951"/>
Budget: <input type="text" value="1378"/>	Budget: <input type="text" value="-60"/>	Budget: <input type="text" value="2554"/>	Budget: <input type="text" value="8685"/>
LRE: <input type="text" value="1393"/>	LRE: <input type="text" value="-46"/>	LRE: <input type="text" value="2573"/>	LRE: <input type="text" value="10085"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag: ☐ C RatingTag: ☐ A WBS #:  1  
WBSDescription:  Design, code, and test flight control software

## Rating Information

Rating Date:  5/15/92 Rating:  2 Rating Type:  SPA (EXT) Rating Relevance:  High  
RateComment:

## Moderating Variables

Acquisition Phase:  Production Contract Type:  FPIF  
Program Comments:  70/30 Share ratio  
S/W Lifecycle:  Release Language:  Jovial Language %:  100.00% Application:  Avionics  
Project Budget:  3622000 Budget Volatility:  None Size:  31000 % New/Modified Code:  100.00%  
Requirements Volatility:  Low Rebaselining:  No Quality Stds On Contract: ☐ Quality Params Tracked: ☒  
Cost Accounting Anomalies:  Minimal effort—Largely complete. May not be enough effort to be a valid data point  
Program Manager Comments:  Additional requirements & clarifications determined to be in or out of scope. Out-of-scope requirements added as ECPs

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text"/> 11/30/91	Date: <input type="text"/> 2/28/92	Date: <input type="text"/> 7/30/92	Date: <input type="text"/> 11/30/92
BCWS: <input type="text"/> 3532	BCWS: <input type="text"/> 3532	BCWS: <input type="text"/> 3538	BCWS: <input type="text"/> 3538
BCWP: <input type="text"/> 3539	BCWP: <input type="text"/> 3539	BCWP: <input type="text"/> 3545	BCWP: <input type="text"/> 3545
ACWP: <input type="text"/> 3705	ACWP: <input type="text"/> 3716	ACWP: <input type="text"/> 3716	ACWP: <input type="text"/> 3716
Budget: <input type="text"/> 3615	Budget: <input type="text"/> 3601	Budget: <input type="text"/> 3617	Budget: <input type="text"/> 3622
LRE: <input type="text"/> 3705	LRE: <input type="text"/> 3716	LRE: <input type="text"/> 3716	LRE: <input type="text"/> 3716

## Derived Moderators

Budget Volatility Index:  0.00194 LRE Volatility Index:  0.003 Percent Complete:  0.9787  
BCWS Activity:  0.0017 BCWP Activity:  0.00169 ACWP Activity:  0.00296

## Dependent Variables

Schedule Performance Index:  1 Cost Performance Index:  0.54545

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level.

## Data Identification

OrgTag: D RatingTag: A WBS #: 2

WBSDescription: Define requirements for each CSCI, perform updates to legacy system

## Rating Information

Rating Date: 5/15/91 Rating: 1 Rating Type: SPA (EXT) Rating Relevance: High

RateComment: Information provided by Contractor (no program office intermediary)

## Moderating Variables

Acquisition Phase: EMD Contract Type: CPFF

Program Comments: Program was cancelled.

S/W Lifecycle: Test/Integration Language: Jovial Language %: 100.00% Application: Other

Project Budget: 6282000 Budget Volatility: Low Size: 150000 % New/Modified Code: 60.00%

Requirements Volatility: High Rebaselining: No Quality Stds On Contract: ☒ Quality Params Tracked: ☐

Cost Accounting Anomalies:

Program Manager Comments: Program was "overcome by events" and was thus cancelled.

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <u>12/30/90</u>	Date: <u>3/30/91</u>	Date: <u>8/30/91</u>	Date: <u>11/30/91</u>
BCWS: <u>3823</u>	BCWS: <u>4197</u>	BCWS: <u>4868</u>	BCWS: <u>5109</u>
BCWP: <u>3639</u>	BCWP: <u>4114</u>	BCWP: <u>4750</u>	BCWP: <u>4997</u>
ACWP: <u>4581</u>	ACWP: <u>5269</u>	ACWP: <u>5958</u>	ACWP: <u>6179</u>
Budget: <u>4445</u>	Budget: <u>4850</u>	Budget: <u>5000</u>	Budget: <u>6282</u>
LRE: <u>5359</u>	LRE: <u>6135</u>	LRE: <u>6275</u>	LRE: <u>7562</u>

## Derived Moderators

Budget Volatility Index: 0.41327 LRE Volatility Index: 0.4111 Percent Complete: 0.7954

BCWS Activity: 0.25171 BCWP Activity: 0.27176 ACWP Activity: 0.25862

## Dependent Variables

Schedule Performance Index: 1.055988 Cost Performance Index: 0.84981

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

SW Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="12/30/91"/>	Date: <input type="text" value="3/30/92"/>	Date: <input type="text" value="8/30/92"/>	Date: <input type="text" value="11/30/92"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="8175"/>	BCWS: <input type="text" value="21673"/>	BCWS: <input type="text" value="29342"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="7418"/>	BCWP: <input type="text" value="18553"/>	BCWP: <input type="text" value="26298"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="7425"/>	ACWP: <input type="text" value="19140"/>	ACWP: <input type="text" value="28359"/>
Budget: <input type="text" value="316251"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="316251"/>
LRE: <input type="text" value="316251"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="316251"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="12/30/91"/>	Date: <input type="text" value="3/30/92"/>	Date: <input type="text" value="8/30/92"/>	Date: <input type="text" value="11/30/92"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="7238"/>	BCWS: <input type="text" value="13302"/>	BCWS: <input type="text" value="13756"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="7516"/>	BCWP: <input type="text" value="12763"/>	BCWP: <input type="text" value="11531"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="6796"/>	ACWP: <input type="text" value="11835"/>	ACWP: <input type="text" value="12193"/>
Budget: <input type="text" value="48634"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="45545"/>
LRE: <input type="text" value="48634"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="45545"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:   
Project Budget:  Budget Volatility:  Size:  % New/Modified Code:   
Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="1/30/94"/>	Date: <input type="text" value="4/30/94"/>
BCWS: <input type="text" value="46194"/>	BCWS: <input type="text" value="54897"/>	BCWS: <input type="text" value="69751"/>	BCWS: <input type="text" value="79080"/>
BCWP: <input type="text" value="43675"/>	BCWP: <input type="text" value="52012"/>	BCWP: <input type="text" value="68831"/>	BCWP: <input type="text" value="77422"/>
ACWP: <input type="text" value="43806"/>	ACWP: <input type="text" value="51350"/>	ACWP: <input type="text" value="64021"/>	ACWP: <input type="text" value="73745"/>
Budget: <input type="text" value="300751"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="262222"/>
LRE: <input type="text" value="300751"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="250617"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:   
BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="1/30/94"/>	Date: <input type="text" value="4/30/94"/>
BCWS: <input type="text" value="20629"/>	BCWS: <input type="text" value="25284"/>	BCWS: <input type="text" value="33814"/>	BCWS: <input type="text" value="38988"/>
BCWP: <input type="text" value="20043"/>	BCWP: <input type="text" value="25515"/>	BCWP: <input type="text" value="32271"/>	BCWP: <input type="text" value="38160"/>
ACWP: <input type="text" value="21518"/>	ACWP: <input type="text" value="26902"/>	ACWP: <input type="text" value="34756"/>	ACWP: <input type="text" value="39963"/>
Budget: <input type="text" value="61045"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="87704"/>
LRE: <input type="text" value="61045"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="88890"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☐Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Three Months Prior to  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Three Months  
After RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Six Months After  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: 

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: 

Investigator Comments:



## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☒Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="9/30/90"/>	Date: <input type="text" value="2/28/91"/>	Date: <input type="text" value="5/30/91"/>
BCWS: <input type="text" value="21589"/>	BCWS: <input type="text" value="22208"/>	BCWS: <input type="text" value="22775"/>	BCWS: <input type="text" value="22775"/>
BCWP: <input type="text" value="20433"/>	BCWP: <input type="text" value="21754"/>	BCWP: <input type="text" value="22665"/>	BCWP: <input type="text" value="22648"/>
ACWP: <input type="text" value="61144"/>	ACWP: <input type="text" value="64402"/>	ACWP: <input type="text" value="69137"/>	ACWP: <input type="text" value="72116"/>
Budget: <input type="text" value="22775"/>	Budget: <input type="text" value="22775"/>	Budget: <input type="text" value="22788"/>	Budget: <input type="text" value="22788"/>
LRE: <input type="text" value="66623"/>	LRE: <input type="text" value="68767"/>	LRE: <input type="text" value="78000"/>	LRE: <input type="text" value="77549"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments: 

CPI moderate low outlier; SPI extreme high outlier. Investigation reveals valid data point. Negligible influence on cumulative SPI (.946 to .994), and CPI (.334 to .314).

## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☒Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/92"/>	Date: <input type="text" value="9/30/92"/>	Date: <input type="text" value="2/28/93"/>	Date: <input type="text" value="4/30/93"/>
BCWS: <input type="text" value="81331"/>	BCWS: <input type="text" value="82091"/>	BCWS: <input type="text" value="82377"/>	BCWS: <input type="text" value="82377"/>
BCWP: <input type="text" value="81248"/>	BCWP: <input type="text" value="82095"/>	BCWP: <input type="text" value="82375"/>	BCWP: <input type="text" value="82375"/>
ACWP: <input type="text" value="82324"/>	ACWP: <input type="text" value="83712"/>	ACWP: <input type="text" value="85117"/>	ACWP: <input type="text" value="85548"/>
Budget: <input type="text" value="81895"/>	Budget: <input type="text" value="82330"/>	Budget: <input type="text" value="82378"/>	Budget: <input type="text" value="82378"/>
LRE: <input type="text" value="82692"/>	LRE: <input type="text" value="86042"/>	LRE: <input type="text" value="85431"/>	LRE: <input type="text" value="86463"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/92"/>	Date: <input type="text" value="8/30/92"/>	Date: <input type="text" value="1/30/93"/>	Date: <input type="text" value="4/30/93"/>
BCWS: <input type="text" value="2863"/>	BCWS: <input type="text" value="4294"/>	BCWS: <input type="text" value="4879"/>	BCWS: <input type="text" value="6178"/>
BCWP: <input type="text" value="2652"/>	BCWP: <input type="text" value="3736"/>	BCWP: <input type="text" value="4879"/>	BCWP: <input type="text" value="6124"/>
ACWP: <input type="text" value="2334"/>	ACWP: <input type="text" value="3681"/>	ACWP: <input type="text" value="5251"/>	ACWP: <input type="text" value="6483"/>
Budget: <input type="text" value="16112"/>	Budget: <input type="text" value="16421"/>	Budget: <input type="text" value="11609"/>	Budget: <input type="text" value="12860"/>
LRE: <input type="text" value="16112"/>	LRE: <input type="text" value="16421"/>	LRE: <input type="text" value="11609"/>	LRE: <input type="text" value="12860"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: RatingTag: WBS #: 

WBSDescription:

Software-Related management activities: Baselineing, Software development planning, etc

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☒Quality Params Tracked: ☒Cost Accounting Anomalies: 

Program Manager Comments:

\*\*\*NOTE\*\*\* Quality standard in this case is 2167 (tailored)--need to determine if DOD-STD-2168 or DI-QCIC-80572 is on contract.

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="10/30/89"/>	Date: <input type="text" value="1/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="9/30/90"/>
BCWS: <input type="text" value="2410"/>	BCWS: <input type="text" value="2602"/>	BCWS: <input type="text" value="2943"/>	BCWS: <input type="text" value="2825"/>
BCWP: <input type="text" value="2410"/>	BCWP: <input type="text" value="2602"/>	BCWP: <input type="text" value="2943"/>	BCWP: <input type="text" value="2825"/>
ACWP: <input type="text" value="2401"/>	ACWP: <input type="text" value="2538"/>	ACWP: <input type="text" value="2745"/>	ACWP: <input type="text" value="2830"/>
Budget: <input type="text" value="3083"/>	Budget: <input type="text" value="3083"/>	Budget: <input type="text" value="3083"/>	Budget: <input type="text" value="3267"/>
LRE: <input type="text" value="3153"/>	LRE: <input type="text" value="3151"/>	LRE: <input type="text" value="2953"/>	LRE: <input type="text" value="3267"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☒

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="10/30/89"/>	Date: <input type="text" value="1/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="9/30/90"/>
BCWS: <input type="text" value="2244"/>	BCWS: <input type="text" value="2306"/>	BCWS: <input type="text" value="2568"/>	BCWS: <input type="text" value="2621"/>
BCWP: <input type="text" value="2178"/>	BCWP: <input type="text" value="2226"/>	BCWP: <input type="text" value="2452"/>	BCWP: <input type="text" value="2620"/>
ACWP: <input type="text" value="2169"/>	ACWP: <input type="text" value="2340"/>	ACWP: <input type="text" value="2582"/>	ACWP: <input type="text" value="2724"/>
Budget: <input type="text" value="3084"/>	Budget: <input type="text" value="3087"/>	Budget: <input type="text" value="3132"/>	Budget: <input type="text" value="4602"/>
LRE: <input type="text" value="3137"/>	LRE: <input type="text" value="3171"/>	LRE: <input type="text" value="3330"/>	LRE: <input type="text" value="4755"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription: Subsystem test, test planning and integration

## Rating Information

Rating Date:  4/15/90 Rating:  3 Rating Type:  SPA (EXT) Rating Relevance:  High

RateComment: SEI conducted the rating

## Moderating Variables

Acquisition Phase:  Upgrade Contract Type:  FPIF

Program Comments:

S/W Lifecycle:  Test Language:  Other Language %:  0.00% Application:  Database

Project Budget:  14880000 Budget Volatility:  Low Size:  0 % New/Modified Code:  0.00%

Requirements Volatility:  Low Rebaselining:  No Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies: Rebaselining prior to this period does not affect this measurement—increase in budget in later qtr.

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text"/> 10/30/89	Date: <input type="text"/> 1/30/90	Date: <input type="text"/> 6/30/90	Date: <input type="text"/> 9/30/90
BCWS: <input type="text"/> 5189	BCWS: <input type="text"/> 5892	BCWS: <input type="text"/> 6881	BCWS: <input type="text"/> 6948
BCWP: <input type="text"/> 5038	BCWP: <input type="text"/> 5652	BCWP: <input type="text"/> 6739	BCWP: <input type="text"/> 6949
ACWP: <input type="text"/> 5029	ACWP: <input type="text"/> 5698	ACWP: <input type="text"/> 6635	ACWP: <input type="text"/> 6968
Budget: <input type="text"/> 10226	Budget: <input type="text"/> 10234	Budget: <input type="text"/> 10374	Budget: <input type="text"/> 14880
LRE: <input type="text"/> 11023	LRE: <input type="text"/> 10900	LRE: <input type="text"/> 11006	LRE: <input type="text"/> 15773

## Derived Moderators

Budget Volatility Index:  0.45511 LRE Volatility Index:  0.4309 Percent Complete:  0.467

BCWS Activity:  0.25317 BCWP Activity:  0.275 ACWP Activity:  0.27827

## Dependent Variables

Schedule Performance Index:  1.086413 Cost Performance Index:  0.98556

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text"/>
BCWS: <input type="text"/>	BCWS: <input type="text"/>	BCWS: <input type="text"/>	BCWS: <input type="text"/>
BCWP: <input type="text"/>	BCWP: <input type="text"/>	BCWP: <input type="text"/>	BCWP: <input type="text"/>
ACWP: <input type="text"/>	ACWP: <input type="text"/>	ACWP: <input type="text"/>	ACWP: <input type="text"/>
Budget: <input type="text"/>	Budget: <input type="text"/>	Budget: <input type="text"/>	Budget: <input type="text"/>
LRE: <input type="text"/>	LRE: <input type="text"/>	LRE: <input type="text"/>	LRE: <input type="text"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="10/30/89"/>	Date: <input type="text" value="1/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="9/30/90"/>
BCWS: <input type="text" value="2140"/>	BCWS: <input type="text" value="2254"/>	BCWS: <input type="text" value="2364"/>	BCWS: <input type="text" value="2362"/>
BCWP: <input type="text" value="2085"/>	BCWP: <input type="text" value="2225"/>	BCWP: <input type="text" value="2344"/>	BCWP: <input type="text" value="2356"/>
ACWP: <input type="text" value="2010"/>	ACWP: <input type="text" value="2167"/>	ACWP: <input type="text" value="2298"/>	ACWP: <input type="text" value="2352"/>
Budget: <input type="text" value="3056"/>	Budget: <input type="text" value="3077"/>	Budget: <input type="text" value="3077"/>	Budget: <input type="text" value="3822"/>
LRE: <input type="text" value="2983"/>	LRE: <input type="text" value="3032"/>	LRE: <input type="text" value="3095"/>	LRE: <input type="text" value="3822"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: ☐ RatingTag: ☐ WBS #: ☐

WBSDescription: Software-Related management activities: Baselining, Software development planning, etc

## Rating Information

Rating Date: ☐ 10/15/91 Rating: ☐ 1 Rating Type: ☐ SCE Rating Relevance: ☐ High

RateComment:

## Moderating Variables

Acquisition Phase: ☐ Upgrade Contract Type: ☐ Other

Program Comments: contract converted from FPI to FPI/CPFF during this period

S/W Lifecycle: ☐ Multiple-Early Language: ☐ Other Language %: ☐ 0.00% Application: ☐ Database

Project Budget: ☐ 2521000 Budget Volatility: ☐ Low Size: ☐ 0 % New/Modified Code: ☐ 0.00%

Requirements Volatility: ☐ Med Rebaselining: ☐ No Quality Stds On Contract: ☐ Quality Params Tracked: ☐

Cost Accounting Anomalies: \*\*INVALID DATA POINT\*\* May have moved work during this period (Aug 91)—indicated decrease in budget and actuals

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="checkbox"/> 5/30/91	Date: <input type="checkbox"/> 8/30/91	Date: <input type="checkbox"/> 1/30/92	Date: <input type="checkbox"/> 4/30/92
BCWS: <input type="checkbox"/> 3054	BCWS: <input type="checkbox"/> 2237	BCWS: <input type="checkbox"/> 2327	BCWS: <input type="checkbox"/> 2368
BCWP: <input type="checkbox"/> 3054	BCWP: <input type="checkbox"/> 2237	BCWP: <input type="checkbox"/> 2327	BCWP: <input type="checkbox"/> 2368
ACWP: <input type="checkbox"/> 3080	ACWP: <input type="checkbox"/> 2275	ACWP: <input type="checkbox"/> 2357	ACWP: <input type="checkbox"/> 2492
Budget: <input type="checkbox"/> 3273	Budget: <input type="checkbox"/> 2387	Budget: <input type="checkbox"/> 2387	Budget: <input type="checkbox"/> 2521
LRE: <input type="checkbox"/> 3334	LRE: <input type="checkbox"/> 2438	LRE: <input type="checkbox"/> 2429	LRE: <input type="checkbox"/> 2693

## Derived Moderators

Budget Volatility Index: ☐ -0.2298 LRE Volatility Index: ☐ -0.192 Percent Complete: ☐ 0.9393

BCWS Activity: ☐ -0.2897 BCWP Activity: ☐ -0.2897 ACWP Activity: ☐ -0.236

## Dependent Variables

Schedule Performance Index: ☐ 1 Cost Performance Index: ☐ 1.16667

Investigator Comments:

\*\*INVALID DATA POINT\*\* Accumulated costs (ACWP, BCWP) moved from this project during the period of interest. Invalidates calculation of performance indices.



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="3390"/>	BCWS: <input type="text" value="3724"/>	BCWS: <input type="text" value="4157"/>	BCWS: <input type="text" value="4466"/>
BCWP: <input type="text" value="3296"/>	BCWP: <input type="text" value="3646"/>	BCWP: <input type="text" value="4099"/>	BCWP: <input type="text" value="4322"/>
ACWP: <input type="text" value="3471"/>	ACWP: <input type="text" value="3840"/>	ACWP: <input type="text" value="4405"/>	ACWP: <input type="text" value="4679"/>
Budget: <input type="text" value="4632"/>	Budget: <input type="text" value="4674"/>	Budget: <input type="text" value="4674"/>	Budget: <input type="text" value="5015"/>
LRE: <input type="text" value="4890"/>	LRE: <input type="text" value="5314"/>	LRE: <input type="text" value="5343"/>	LRE: <input type="text" value="5560"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:   
WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:   
RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:   
Program Comments:   
S/W Lifecycle:  Language:  Language %:  Application:   
Project Budget:  Budget Volatility:  Size:  % New/Modified Code:   
Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒  
Cost Accounting Anomalies:   
Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="8723"/>	BCWS: <input type="text" value="9700"/>	BCWS: <input type="text" value="11369"/>	BCWS: <input type="text" value="12508"/>
BCWP: <input type="text" value="8678"/>	BCWP: <input type="text" value="9584"/>	BCWP: <input type="text" value="11205"/>	BCWP: <input type="text" value="12359"/>
ACWP: <input type="text" value="8544"/>	ACWP: <input type="text" value="9510"/>	ACWP: <input type="text" value="11360"/>	ACWP: <input type="text" value="12293"/>
Budget: <input type="text" value="15008"/>	Budget: <input type="text" value="15122"/>	Budget: <input type="text" value="15219"/>	Budget: <input type="text" value="15734"/>
LRE: <input type="text" value="15740"/>	LRE: <input type="text" value="16050"/>	LRE: <input type="text" value="15520"/>	LRE: <input type="text" value="15724"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:   
BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text"/>
BCWS: <input type="text"/>	BCWS: <input type="text"/>	BCWS: <input type="text"/>	BCWS: <input type="text"/>
BCWP: <input type="text"/>	BCWP: <input type="text"/>	BCWP: <input type="text"/>	BCWP: <input type="text"/>
ACWP: <input type="text"/>	ACWP: <input type="text"/>	ACWP: <input type="text"/>	ACWP: <input type="text"/>
Budget: <input type="text"/>	Budget: <input type="text"/>	Budget: <input type="text"/>	Budget: <input type="text"/>
LRE: <input type="text"/>	LRE: <input type="text"/>	LRE: <input type="text"/>	LRE: <input type="text"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="3041"/>	BCWS: <input type="text" value="3354"/>	BCWS: <input type="text" value="3722"/>	BCWS: <input type="text" value="3848"/>
BCWP: <input type="text" value="3017"/>	BCWP: <input type="text" value="3261"/>	BCWP: <input type="text" value="3595"/>	BCWP: <input type="text" value="3810"/>
ACWP: <input type="text" value="2973"/>	ACWP: <input type="text" value="3223"/>	ACWP: <input type="text" value="3664"/>	ACWP: <input type="text" value="3946"/>
Budget: <input type="text" value="3964"/>	Budget: <input type="text" value="4014"/>	Budget: <input type="text" value="4023"/>	Budget: <input type="text" value="3953"/>
LRE: <input type="text" value="3981"/>	LRE: <input type="text" value="4055"/>	LRE: <input type="text" value="4097"/>	LRE: <input type="text" value="4118"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="41"/>	BCWS: <input type="text" value="203"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="23"/>	BCWP: <input type="text" value="143"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="8"/>	ACWP: <input type="text" value="139"/>
Budget: <input type="text" value="1074"/>	Budget: <input type="text" value="1074"/>	Budget: <input type="text" value="1074"/>	Budget: <input type="text" value="1871"/>
LRE: <input type="text" value="1289"/>	LRE: <input type="text" value="1289"/>	LRE: <input type="text" value="1283"/>	LRE: <input type="text" value="2095"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

Values for minus 6 month and minus 3 month Budget and LRE are from Oct 91 CPR, which reflects first indication of activity. This was done to avoid DIV 0 errors for derived moderators.

## Data Identification

OrgTag: ☐RatingTag: ☒WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: SW Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☐Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Three Months Prior to  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Three Months  
After RatingDate: BCWS: BCWP: ACWP: Budget: LRE: Six Months After  
RatingDate: BCWS: BCWP: ACWP: Budget: LRE: 

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="9/30/92"/>	Date: <input type="text" value="12/30/92"/>	Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>
BCWS: <input type="text" value="4753"/>	BCWS: <input type="text" value="4977"/>	BCWS: <input type="text" value="5106"/>	BCWS: <input type="text" value="5118"/>
BCWP: <input type="text" value="4726"/>	BCWP: <input type="text" value="4975"/>	BCWP: <input type="text" value="5100"/>	BCWP: <input type="text" value="5105"/>
ACWP: <input type="text" value="5041"/>	ACWP: <input type="text" value="5327"/>	ACWP: <input type="text" value="5597"/>	ACWP: <input type="text" value="5715"/>
Budget: <input type="text" value="5156"/>	Budget: <input type="text" value="5156"/>	Budget: <input type="text" value="5142"/>	Budget: <input type="text" value="5142"/>
LRE: <input type="text" value="5652"/>	LRE: <input type="text" value="5715"/>	LRE: <input type="text" value="5659"/>	LRE: <input type="text" value="5759"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription: Subsystem test, test planning and integration

## Rating Information

Rating Date:  3/15/93 Rating:  1 Rating Type:  SCE Rating Relevance:  High

RateComment:

## Moderating Variables

Acquisition Phase:  Upgrade Contract Type:  Other

Program Comments:  contract FPI/CPFF

S/W Lifecycle:  Test Language:  Other Language %:  0.00% Application:  Database

Project Budget:  15867000 Budget Volatility:  Low Size:  0 % New/Modified Code:  0.00%

Requirements Volatility:  Low Rebaselining:  No Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text"/> 9/30/92	Date: <input type="text"/> 12/30/92	Date: <input type="text"/> 5/30/93	Date: <input type="text"/> 8/30/93
BCWS: <input type="text"/> 14279	BCWS: <input type="text"/> 14761	BCWS: <input type="text"/> 15363	BCWS: <input type="text"/> 15730
BCWP: <input type="text"/> 14204	BCWP: <input type="text"/> 14654	BCWP: <input type="text"/> 15274	BCWP: <input type="text"/> 15668
ACWP: <input type="text"/> 13708	ACWP: <input type="text"/> 14388	ACWP: <input type="text"/> 15126	ACWP: <input type="text"/> 15455
Budget: <input type="text"/> 15958	Budget: <input type="text"/> 15958	Budget: <input type="text"/> 15867	Budget: <input type="text"/> 15867
LRE: <input type="text"/> 15709	LRE: <input type="text"/> 15647	LRE: <input type="text"/> 15507	LRE: <input type="text"/> 15627

## Derived Moderators

Budget Volatility Index:  -0.0057 LRE Volatility Index:  -0.005 Percent Complete:  0.9875

BCWS Activity:  0.09224 BCWP Activity:  0.09344 ACWP Activity:  0.11304

## Dependent Variables

Schedule Performance Index:  1.008959 Cost Performance Index:  0.83801

Investigator Comments:

Selected for model validation.



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="9/30/92"/>	Date: <input type="text" value="12/30/92"/>	Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>
BCWS: <input type="text" value="17495"/>	BCWS: <input type="text" value="17943"/>	BCWS: <input type="text" value="18220"/>	BCWS: <input type="text" value="18233"/>
BCWP: <input type="text" value="17225"/>	BCWP: <input type="text" value="17893"/>	BCWP: <input type="text" value="18181"/>	BCWP: <input type="text" value="18216"/>
ACWP: <input type="text" value="19613"/>	ACWP: <input type="text" value="20393"/>	ACWP: <input type="text" value="21156"/>	ACWP: <input type="text" value="21540"/>
Budget: <input type="text" value="18286"/>	Budget: <input type="text" value="18263"/>	Budget: <input type="text" value="18238"/>	Budget: <input type="text" value="18238"/>
LRE: <input type="text" value="20531"/>	LRE: <input type="text" value="20859"/>	LRE: <input type="text" value="21366"/>	LRE: <input type="text" value="21639"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="9/30/92"/>	Date: <input type="text" value="12/30/92"/>	Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>
BCWS: <input type="text" value="3940"/>	BCWS: <input type="text" value="3952"/>	BCWS: <input type="text" value="3951"/>	BCWS: <input type="text" value="3951"/>
BCWP: <input type="text" value="3937"/>	BCWP: <input type="text" value="3952"/>	BCWP: <input type="text" value="3951"/>	BCWP: <input type="text" value="3951"/>
ACWP: <input type="text" value="4167"/>	ACWP: <input type="text" value="4238"/>	ACWP: <input type="text" value="4385"/>	ACWP: <input type="text" value="4436"/>
Budget: <input type="text" value="3951"/>	Budget: <input type="text" value="3952"/>	Budget: <input type="text" value="3951"/>	Budget: <input type="text" value="3951"/>
LRE: <input type="text" value="4217"/>	LRE: <input type="text" value="4273"/>	LRE: <input type="text" value="4386"/>	LRE: <input type="text" value="4436"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="9/30/92"/>	Date: <input type="text" value="12/30/92"/>	Date: <input type="text" value="5/30/93"/>	Date: <input type="text" value="8/30/93"/>
BCWS: <input type="text" value="1193"/>	BCWS: <input type="text" value="1747"/>	BCWS: <input type="text" value="2138"/>	BCWS: <input type="text" value="2321"/>
BCWP: <input type="text" value="1079"/>	BCWP: <input type="text" value="1627"/>	BCWP: <input type="text" value="2033"/>	BCWP: <input type="text" value="2224"/>
ACWP: <input type="text" value="904"/>	ACWP: <input type="text" value="1334"/>	ACWP: <input type="text" value="1870"/>	ACWP: <input type="text" value="2076"/>
Budget: <input type="text" value="2319"/>	Budget: <input type="text" value="2342"/>	Budget: <input type="text" value="2521"/>	Budget: <input type="text" value="2521"/>
LRE: <input type="text" value="2657"/>	LRE: <input type="text" value="2552"/>	LRE: <input type="text" value="2604"/>	LRE: <input type="text" value="2603"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag: ☐ RatingTag: ☐ WBS #: ☐

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

SW Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="4/30/88"/>	Date: <input type="text" value="7/30/88"/>	Date: <input type="text" value="12/30/88"/>	Date: <input type="text" value="3/30/89"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="100"/>	BCWS: <input type="text" value="675"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="86"/>	BCWP: <input type="text" value="493"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="80"/>	ACWP: <input type="text" value="486"/>
Budget: <input type="text" value="7488"/>	Budget: <input type="text" value="7488"/>	Budget: <input type="text" value="7488"/>	Budget: <input type="text" value="7488"/>
LRE: <input type="text" value="7488"/>	LRE: <input type="text" value="7488"/>	LRE: <input type="text" value="7488"/>	LRE: <input type="text" value="7492"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

Values for minus 6 month and minus 3 month Budget and LRE are from Dec 88 CPR. This was done to avoid DIV 0 errors for derived moderators. Program initiated when organization was rated. Data representative of 12 months after rating only

## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="4/30/88"/>	Date: <input type="text" value="7/30/88"/>	Date: <input type="text" value="12/30/88"/>	Date: <input type="text" value="3/30/89"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="89"/>	BCWS: <input type="text" value="360"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="19"/>	BCWP: <input type="text" value="109"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="20"/>	ACWP: <input type="text" value="107"/>
Budget: <input type="text" value="2557"/>	Budget: <input type="text" value="2557"/>	Budget: <input type="text" value="2557"/>	Budget: <input type="text" value="2557"/>
LRE: <input type="text" value="2557"/>	LRE: <input type="text" value="2557"/>	LRE: <input type="text" value="2557"/>	LRE: <input type="text" value="2557"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete: BCWS Activity:  BCWP Activity:  ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:

RatingTag:

WBS #:

WBSDescription:

## Rating Information

Rating Date:

Rating:

Rating Type:

Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="4/30/88"/>	Date: <input type="text" value="7/30/88"/>	Date: <input type="text" value="12/30/88"/>	Date: <input type="text" value="3/30/89"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="189"/>	BCWS: <input type="text" value="518"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="161"/>	BCWP: <input type="text" value="452"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="164"/>	ACWP: <input type="text" value="419"/>
Budget: <input type="text" value="3284"/>	Budget: <input type="text" value="3284"/>	Budget: <input type="text" value="3284"/>	Budget: <input type="text" value="3284"/>
LRE: <input type="text" value="3284"/>	LRE: <input type="text" value="3284"/>	LRE: <input type="text" value="3284"/>	LRE: <input type="text" value="3283"/>

## Derived Moderators

Budget Volatility Index:

LRE Volatility Index:

Percent Complete:

BCWS Activity:

BCWP Activity:

ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

Values for minus 6 month and minus 3 month Budget and LRE are from Dec 88 CPR. This was done to avoid DIV 0 errors for derived moderators. Program initiated when organization was rated. Data representative of 12 months after rating only

## Data Identification

OrgTag:  RatingTag:  WBS #:   
WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:   
RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:   
Program Comments:   
S/W Lifecycle:  Language:  Language %:  Application:   
Project Budget:  Budget Volatility:  Size:  % New/Modified Code:   
Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒  
Cost Accounting Anomalies:   
Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="10/30/90"/>	Date: <input type="text" value="1/30/91"/>	Date: <input type="text" value="6/30/91"/>	Date: <input type="text" value="9/30/91"/>
BCWS: <input type="text" value="6521"/>	BCWS: <input type="text" value="7255"/>	BCWS: <input type="text" value="7928"/>	BCWS: <input type="text" value="7998"/>
BCWP: <input type="text" value="6671"/>	BCWP: <input type="text" value="7260"/>	BCWP: <input type="text" value="7853"/>	BCWP: <input type="text" value="8000"/>
ACWP: <input type="text" value="6962"/>	ACWP: <input type="text" value="7697"/>	ACWP: <input type="text" value="8198"/>	ACWP: <input type="text" value="8207"/>
Budget: <input type="text" value="7930"/>	Budget: <input type="text" value="7985"/>	Budget: <input type="text" value="7998"/>	Budget: <input type="text" value="7998"/>
LRE: <input type="text" value="7820"/>	LRE: <input type="text" value="7985"/>	LRE: <input type="text" value="8201"/>	LRE: <input type="text" value="8201"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:   
BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag: ☐ RatingTag: ☐ WBS #: ☐

WBSDescription: Develop requirements, design, code, and test system software

## Rating Information

Rating Date: ☐ 4/15/91 Rating: ☐ 3 Rating Type: ☐ SCE Rating Relevance: ☐ Med

RateComment:

## Moderating Variables

Acquisition Phase: ☐ EMD Contract Type: ☐ FPIF

Program Comments: Follow-on to previous similar efforts

S/W Lifecycle: ☐ Test/Integration Language: ☐ Jovial Language %: ☐ 100.00% Application: ☐ Simulation

Project Budget: ☐ 2654000 Budget Volatility: ☐ Low Size: ☐ 42000 % New/Modified Code: ☐ 52.00%

Requirements Volatility: ☐ Low Rebaselining: ☐ No Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments: Beat target sched. Size in DSI

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="checkbox"/> 10/30/90	Date: <input type="checkbox"/> 1/30/91	Date: <input type="checkbox"/> 6/30/91	Date: <input type="checkbox"/> 9/30/91
BCWS: <input type="checkbox"/> 2315	BCWS: <input type="checkbox"/> 2450	BCWS: <input type="checkbox"/> 2628	BCWS: <input type="checkbox"/> 2654
BCWP: <input type="checkbox"/> 2217	BCWP: <input type="checkbox"/> 2382	BCWP: <input type="checkbox"/> 2628	BCWP: <input type="checkbox"/> 2655
ACWP: <input type="checkbox"/> 2015	ACWP: <input type="checkbox"/> 2152	ACWP: <input type="checkbox"/> 2235	ACWP: <input type="checkbox"/> 2236
Budget: <input type="checkbox"/> 2654	Budget: <input type="checkbox"/> 2654	Budget: <input type="checkbox"/> 2654	Budget: <input type="checkbox"/> 2654
LRE: <input type="checkbox"/> 2563	LRE: <input type="checkbox"/> 2320	LRE: <input type="checkbox"/> 2235	LRE: <input type="checkbox"/> 2235

## Derived Moderators

Budget Volatility Index: ☐ 0 LRE Volatility Index: ☐ -0.128 Percent Complete: ☐ 1.0004

BCWS Activity: ☐ 0.12773 BCWP Activity: ☐ 0.16497 ACWP Activity: ☐ 0.0988

## Dependent Variables

Schedule Performance Index: ☐ 1.292035 Cost Performance Index: ☐ 1.9819

Investigator Comments:

Selected for model validation.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="10/30/90"/>	Date: <input type="text" value="1/30/91"/>	Date: <input type="text" value="6/30/91"/>	Date: <input type="text" value="9/30/91"/>
BCWS: <input type="text" value="3009"/>	BCWS: <input type="text" value="3171"/>	BCWS: <input type="text" value="3400"/>	BCWS: <input type="text" value="3432"/>
BCWP: <input type="text" value="2880"/>	BCWP: <input type="text" value="3086"/>	BCWP: <input type="text" value="3406"/>	BCWP: <input type="text" value="3433"/>
ACWP: <input type="text" value="3252"/>	ACWP: <input type="text" value="3395"/>	ACWP: <input type="text" value="3506"/>	ACWP: <input type="text" value="3508"/>
Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>
LRE: <input type="text" value="3497"/>	LRE: <input type="text" value="3497"/>	LRE: <input type="text" value="3513"/>	LRE: <input type="text" value="3507"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: ☐ J RatingTag: ☐ C WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="7852"/>	BCWS: <input type="text" value="7998"/>	BCWS: <input type="text" value="7998"/>	BCWS: <input type="text" value="7998"/>
BCWP: <input type="text" value="7769"/>	BCWP: <input type="text" value="7998"/>	BCWP: <input type="text" value="7997"/>	BCWP: <input type="text" value="7998"/>
ACWP: <input type="text" value="8171"/>	ACWP: <input type="text" value="8201"/>	ACWP: <input type="text" value="8195"/>	ACWP: <input type="text" value="8195"/>
Budget: <input type="text" value="7998"/>	Budget: <input type="text" value="7998"/>	Budget: <input type="text" value="7998"/>	Budget: <input type="text" value="7998"/>
LRE: <input type="text" value="8186"/>	LRE: <input type="text" value="8201"/>	LRE: <input type="text" value="8204"/>	LRE: <input type="text" value="8195"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level.

## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="2605"/>	BCWS: <input type="text" value="2654"/>	BCWS: <input type="text" value="2654"/>	BCWS: <input type="text" value="2654"/>
BCWP: <input type="text" value="2605"/>	BCWP: <input type="text" value="2654"/>	BCWP: <input type="text" value="2654"/>	BCWP: <input type="text" value="2654"/>
ACWP: <input type="text" value="2233"/>	ACWP: <input type="text" value="2235"/>	ACWP: <input type="text" value="2233"/>	ACWP: <input type="text" value="2233"/>
Budget: <input type="text" value="2654"/>	Budget: <input type="text" value="2654"/>	Budget: <input type="text" value="2654"/>	Budget: <input type="text" value="2654"/>
LRE: <input type="text" value="2235"/>	LRE: <input type="text" value="2235"/>	LRE: <input type="text" value="2235"/>	LRE: <input type="text" value="2233"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:



## Data Identification

OrgTag: ☐ JRatingTag: ☐ CWBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/91"/>	Date: <input type="text" value="8/30/91"/>	Date: <input type="text" value="1/30/92"/>	Date: <input type="text" value="4/30/92"/>
BCWS: <input type="text" value="3366"/>	BCWS: <input type="text" value="3432"/>	BCWS: <input type="text" value="3432"/>	BCWS: <input type="text" value="3432"/>
BCWP: <input type="text" value="3363"/>	BCWP: <input type="text" value="3432"/>	BCWP: <input type="text" value="3431"/>	BCWP: <input type="text" value="3432"/>
ACWP: <input type="text" value="3493"/>	ACWP: <input type="text" value="3507"/>	ACWP: <input type="text" value="3506"/>	ACWP: <input type="text" value="3506"/>
Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>	Budget: <input type="text" value="3432"/>
LRE: <input type="text" value="3513"/>	LRE: <input type="text" value="3507"/>	LRE: <input type="text" value="3507"/>	LRE: <input type="text" value="3506"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: 

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/90"/>
BCWS: <input type="text" value="6767"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text"/>	BCWS: <input type="text" value="7863"/>
BCWP: <input type="text" value="6755"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text"/>	BCWP: <input type="text" value="7821"/>
ACWP: <input type="text" value="7060"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text"/>	ACWP: <input type="text" value="8288"/>
Budget: <input type="text" value="7475"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text"/>	Budget: <input type="text" value="8451"/>
LRE: <input type="text" value="7684"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text"/>	LRE: <input type="text" value="8714"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription: Overall mangement of software development effort

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/90"/>
BCWS: <input type="text" value="2025"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2824"/>
BCWP: <input type="text" value="2025"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2824"/>
ACWP: <input type="text" value="2071"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2727"/>
Budget: <input type="text" value="2237"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="3205"/>
LRE: <input type="text" value="2334"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="3351"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:

BCWP Activity:

ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/89"/>
BCWS: <input type="text" value="2158"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2440"/>
BCWP: <input type="text" value="2160"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2416"/>
ACWP: <input type="text" value="2158"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2334"/>
Budget: <input type="text" value="2415"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="2440"/>
LRE: <input type="text" value="2412"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="2437"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag: K RatingTag: A WBS #: 5

WBSDescription: Requirements, design, code, and test of systems interface CSCI

## Rating Information

Rating Date: 12/15/89 Rating: 2 Rating Type: SPA (INT) Rating Relevance: High

RateComment:

## Moderating Variables

Acquisition Phase: Support/Upgrade

Contract Type: FPIF

Program Comments:

S/W Lifecycle: Multiple

Language: Fortran

Language %: 100.00%

Application: Database

Project Budget: 4238000

Budget Volatility: Low

Size: 43200

% New/Modified Code: 85.00%

Requirements Volatility: Low

Rebaselining: No

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies: No +/- three month data

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <u>6/30/89</u>	Date: <u></u>	Date: <u></u>	Date: <u>5/30/90</u>
BCWS: <u>2286</u>	BCWS: <u>0</u>	BCWS: <u>0</u>	BCWS: <u>3268</u>
BCWP: <u>2279</u>	BCWP: <u>0</u>	BCWP: <u>0</u>	BCWP: <u>3167</u>
ACWP: <u>2190</u>	ACWP: <u>0</u>	ACWP: <u>0</u>	ACWP: <u>2989</u>
Budget: <u>2581</u>	Budget: <u>0</u>	Budget: <u>0</u>	Budget: <u>4238</u>
LRE: <u>2515</u>	LRE: <u>0</u>	LRE: <u>0</u>	LRE: <u>4169</u>

## Derived Moderators

Budget Volatility Index: 0.642

LRE Volatility Index: 0.6577

Percent Complete: 0.7473

BCWS Activity: 0.30049

BCWP Activity: 0.28039

ACWP Activity: 0.26731

## Dependent Variables

Schedule Performance Index: 0.904277

Cost Performance Index: 1.11139

Investigator Comments:

No data for plus/minus three month.



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to  
Rating

Date:

BCWS:

BCWP:

ACWP:

Budget:

LRE:

Three Months Prior to  
Rating

Date:

BCWS:

BCWP:

ACWP:

Budget:

LRE:

Three Months  
After Rating

Date:

BCWS:

BCWP:

ACWP:

Budget:

LRE:

Six Months After  
Rating

Date:

BCWS:

BCWP:

ACWP:

Budget:

LRE:

## Derived Moderators

Budget Volatility Index:

LRE Volatility Index:

Percent Complete:

BCWS Activity:

BCWP Activity:

ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

SW Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/90"/>
BCWS: <input type="text" value="2486"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2650"/>
BCWP: <input type="text" value="2488"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2650"/>
ACWP: <input type="text" value="2787"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2866"/>
Budget: <input type="text" value="2616"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="2667"/>
LRE: <input type="text" value="2991"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="2874"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/90"/>
BCWS: <input type="text" value="1162"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="1175"/>
BCWP: <input type="text" value="1160"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="1175"/>
ACWP: <input type="text" value="1258"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="1266"/>
Budget: <input type="text" value="1162"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="1181"/>
LRE: <input type="text" value="1262"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="1277"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level. No data for plus/minus three month.



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="6/30/89"/>	Date: <input type="text"/>	Date: <input type="text"/>	Date: <input type="text" value="5/30/90"/>
BCWS: <input type="text" value="3009"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="4949"/>
BCWP: <input type="text" value="3002"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="4784"/>
ACWP: <input type="text" value="5287"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="7574"/>
Budget: <input type="text" value="5928"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="5821"/>
LRE: <input type="text" value="7906"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="8375"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="7675"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text"/>	BCWS: <input type="text" value="8503"/>
BCWP: <input type="text" value="7647"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text"/>	BCWP: <input type="text" value="8490"/>
ACWP: <input type="text" value="8078"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text"/>	ACWP: <input type="text" value="9002"/>
Budget: <input type="text" value="8451"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text"/>	Budget: <input type="text" value="8586"/>
LRE: <input type="text" value="8695"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text"/>	LRE: <input type="text" value="9122"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="2679"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="3211"/>
BCWP: <input type="text" value="2679"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="3211"/>
ACWP: <input type="text" value="2609"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="3116"/>
Budget: <input type="text" value="3205"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="3239"/>
LRE: <input type="text" value="3351"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="3197"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="2440"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2440"/>
BCWP: <input type="text" value="2416"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2440"/>
ACWP: <input type="text" value="2334"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2334"/>
Budget: <input type="text" value="2440"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="2440"/>
LRE: <input type="text" value="2437"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="2333"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:   
BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level. No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="3083"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="4236"/>
BCWP: <input type="text" value="3019"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="4195"/>
ACWP: <input type="text" value="2875"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="3538"/>
Budget: <input type="text" value="4238"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="4236"/>
LRE: <input type="text" value="4172"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="3839"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag: RatingTag: WBS #: WBSDescription: 

## Rating Information

Rating Date: Rating: Rating Type: Rating Relevance: RateComment: 

## Moderating Variables

Acquisition Phase: Contract Type: Program Comments: S/W Lifecycle: Language: Language %: Application: Project Budget: Budget Volatility: Size: % New/Modified Code: Requirements Volatility: Rebaselining: Quality Stds On Contract: ☐Quality Params Tracked: ☒Cost Accounting Anomalies: Program Manager Comments: 

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="2666"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2683"/>
BCWP: <input type="text" value="2653"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2667"/>
ACWP: <input type="text" value="2645"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2649"/>
Budget: <input type="text" value="2683"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="2683"/>
LRE: <input type="text" value="2755"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="2667"/>

## Derived Moderators

Budget Volatility Index: LRE Volatility Index: Percent Complete: BCWS Activity: BCWP Activity: ACWP Activity: 

## Dependent Variables

Schedule Performance Index: Cost Performance Index: Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="2650"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="2666"/>
BCWP: <input type="text" value="2650"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="2666"/>
ACWP: <input type="text" value="2866"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="2870"/>
Budget: <input type="text" value="2667"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="2666"/>
LRE: <input type="text" value="2874"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="2870"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

Data point excluded from Complete Data Set due to low activity level. No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="1175"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="1181"/>
BCWP: <input type="text" value="1175"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="1181"/>
ACWP: <input type="text" value="1266"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="1269"/>
Budget: <input type="text" value="1181"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="1181"/>
LRE: <input type="text" value="1277"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="1269"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:



## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/90"/>	Date: <input type="text" value="6/30/90"/>	Date: <input type="text" value="11/30/90"/>	Date: <input type="text" value="2/28/91"/>
BCWS: <input type="text" value="4564"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="6486"/>
BCWP: <input type="text" value="4426"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="6486"/>
ACWP: <input type="text" value="7084"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="9461"/>
Budget: <input type="text" value="5821"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="0"/>	Budget: <input type="text" value="6874"/>
LRE: <input type="text" value="7384"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="0"/>	LRE: <input type="text" value="10014"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

No data for plus/minus three month.

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:

Contract Type:

Program Comments:

S/W Lifecycle:

Language:

Language %:

Application:

Project Budget:

Budget Volatility:

Size:

% New/Modified Code:

Requirements Volatility:

Rebaselining:

Quality Stds On Contract: ☐

Quality Params Tracked: ☐

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="12/30/91"/>	Date: <input type="text" value="3/30/92"/>	Date: <input type="text" value="8/30/92"/>	Date: <input type="text" value="11/30/92"/>
BCWS: <input type="text" value="2246"/>	BCWS: <input type="text" value="2335"/>	BCWS: <input type="text" value="2716"/>	BCWS: <input type="text" value="2739"/>
BCWP: <input type="text" value="2025"/>	BCWP: <input type="text" value="2203"/>	BCWP: <input type="text" value="2309"/>	BCWP: <input type="text" value="2369"/>
ACWP: <input type="text" value="2937"/>	ACWP: <input type="text" value="3112"/>	ACWP: <input type="text" value="3296"/>	ACWP: <input type="text" value="3367"/>
Budget: <input type="text" value="2716"/>	Budget: <input type="text" value="2726"/>	Budget: <input type="text" value="2726"/>	Budget: <input type="text" value="2726"/>
LRE: <input type="text" value="3222"/>	LRE: <input type="text" value="3226"/>	LRE: <input type="text" value="3226"/>	LRE: <input type="text" value="3226"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:   
WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:   
RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:   
Program Comments:   
S/W Lifecycle:  Language:  Language %:  Application:   
Project Budget:  Budget Volatility:  Size:  % New/Modified Code:   
Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒  
Cost Accounting Anomalies:   
Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="5/30/92"/>	Date: <input type="text" value="8/30/92"/>	Date: <input type="text" value="1/30/93"/>	Date: <input type="text" value="4/30/93"/>
BCWS: <input type="text" value="0"/>	BCWS: <input type="text" value="530"/>	BCWS: <input type="text" value="1688"/>	BCWS: <input type="text" value="2138"/>
BCWP: <input type="text" value="0"/>	BCWP: <input type="text" value="375"/>	BCWP: <input type="text" value="1483"/>	BCWP: <input type="text" value="2080"/>
ACWP: <input type="text" value="0"/>	ACWP: <input type="text" value="300"/>	ACWP: <input type="text" value="1138"/>	ACWP: <input type="text" value="1812"/>
Budget: <input type="text" value="2227"/>	Budget: <input type="text" value="2227"/>	Budget: <input type="text" value="2226"/>	Budget: <input type="text" value="2230"/>
LRE: <input type="text" value="2227"/>	LRE: <input type="text" value="2227"/>	LRE: <input type="text" value="2172"/>	LRE: <input type="text" value="2012"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:   
BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:  Cost Performance Index:   
Investigator Comments:

## Data Identification

OrgTag:  RatingTag:  WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☐ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="3/30/93"/>	Date: <input type="text" value="6/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="2/28/94"/>
BCWS: <input type="text" value="2025"/>	BCWS: <input type="text" value="2199"/>	BCWS: <input type="text" value="2268"/>	BCWS: <input type="text" value="2268"/>
BCWP: <input type="text" value="1947"/>	BCWP: <input type="text" value="2190"/>	BCWP: <input type="text" value="2257"/>	BCWP: <input type="text" value="2257"/>
ACWP: <input type="text" value="1694"/>	ACWP: <input type="text" value="1862"/>	ACWP: <input type="text" value="1974"/>	ACWP: <input type="text" value="2096"/>
Budget: <input type="text" value="2230"/>	Budget: <input type="text" value="2268"/>	Budget: <input type="text" value="2268"/>	Budget: <input type="text" value="2268"/>
LRE: <input type="text" value="2176"/>	LRE: <input type="text" value="2076"/>	LRE: <input type="text" value="1995"/>	LRE: <input type="text" value="2222"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

Schedule Performance Index:

Cost Performance Index:

Investigator Comments:

## Data Identification

OrgTag: ☐ RatingTag: ☒ WBS #:

WBSDescription:

## Rating Information

Rating Date:  Rating:  Rating Type:  Rating Relevance:

RateComment:

## Moderating Variables

Acquisition Phase:  Contract Type:

Program Comments:

S/W Lifecycle:  Language:  Language %:  Application:

Project Budget:  Budget Volatility:  Size:  % New/Modified Code:

Requirements Volatility:  Rebaselining:  Quality Stds On Contract: ☒ Quality Params Tracked: ☒

Cost Accounting Anomalies:

Program Manager Comments:

## Cost Data

Six Months Prior to Rating	Three Months Prior to Rating	Three Months After Rating	Six Months After Rating
Date: <input type="text" value="8/30/93"/>	Date: <input type="text" value="11/30/93"/>	Date: <input type="text" value="4/30/94"/>	Date: <input type="text" value="7/30/94"/>
BCWS: <input type="text" value="1561"/>	BCWS: <input type="text" value="1874"/>	BCWS: <input type="text" value="2767"/>	BCWS: <input type="text" value="2943"/>
BCWP: <input type="text" value="1431"/>	BCWP: <input type="text" value="1609"/>	BCWP: <input type="text" value="2077"/>	BCWP: <input type="text" value="2192"/>
ACWP: <input type="text" value="2448"/>	ACWP: <input type="text" value="3327"/>	ACWP: <input type="text" value="4725"/>	ACWP: <input type="text" value="5669"/>
Budget: <input type="text" value="2889"/>	Budget: <input type="text" value="2900"/>	Budget: <input type="text" value="2950"/>	Budget: <input type="text" value="3153"/>
LRE: <input type="text" value="4392"/>	LRE: <input type="text" value="5378"/>	LRE: <input type="text" value="6703"/>	LRE: <input type="text" value="6980"/>

## Derived Moderators

Budget Volatility Index:  LRE Volatility Index:  Percent Complete:

BCWS Activity:  BCWP Activity:  ACWP Activity:

## Dependent Variables

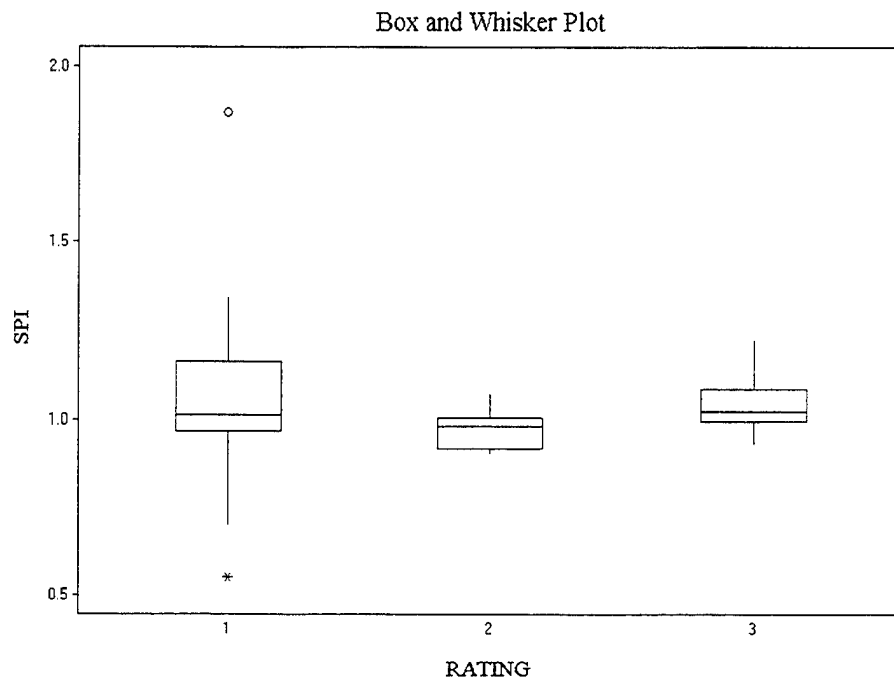
Schedule Performance Index:  Cost Performance Index:

Investigator Comments:

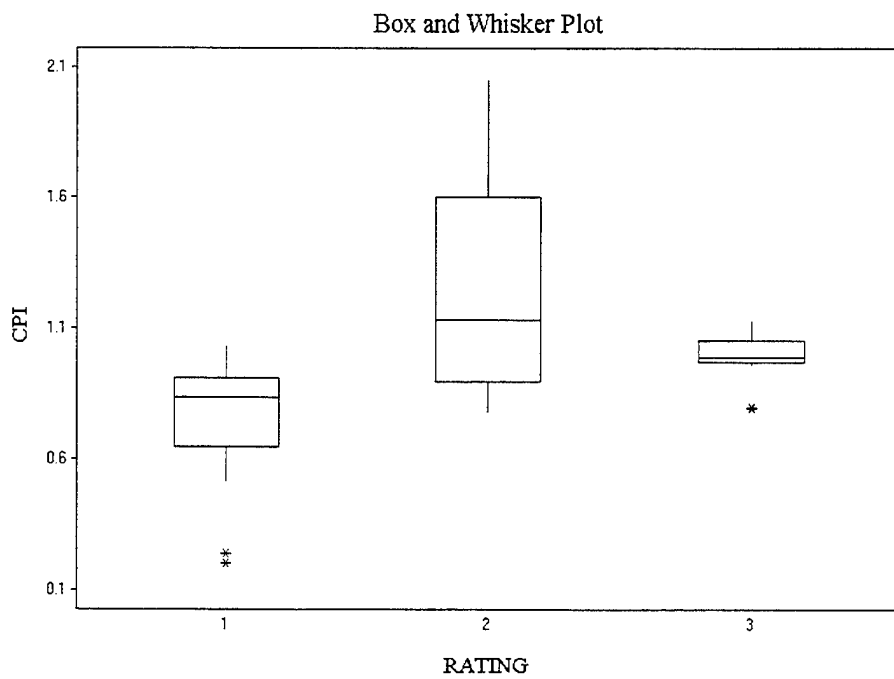
## **Appendix B: Data Supporting Analysis of Complete Data Set**

This appendix contains the complete set of plots used to support the assumptions of normality. The plots were constructed by the statistical software package, *Statistix for Windows*.

## 1. Box Plots of CPI and SPI

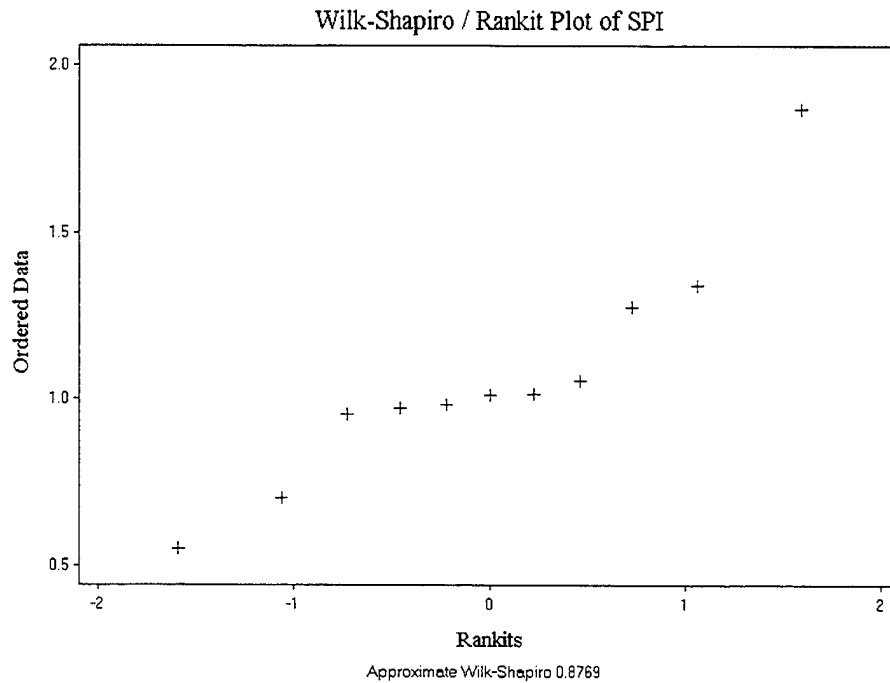


**Figure B-1 Box Plot of SPI for Complete Data Set**

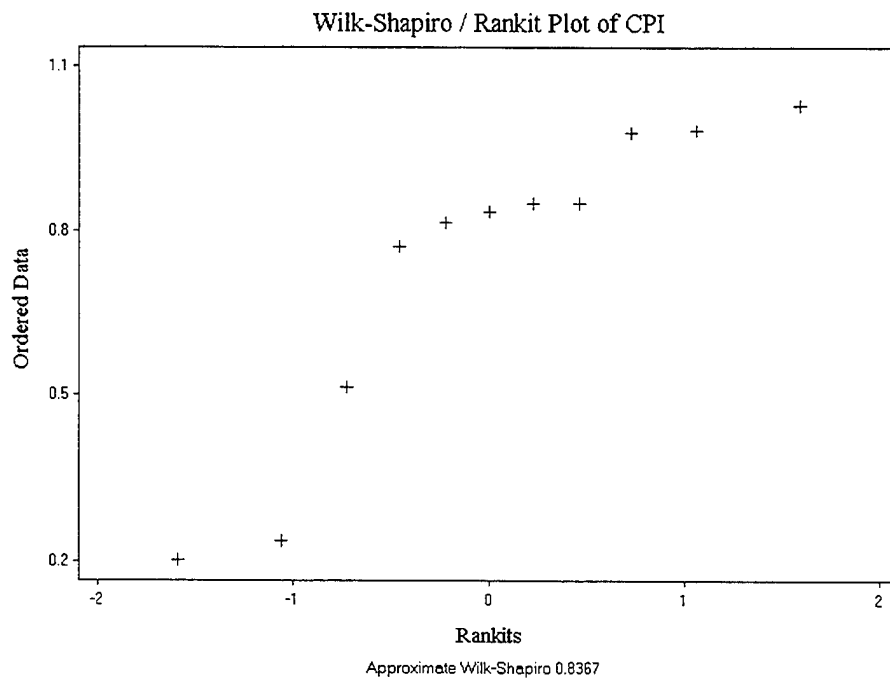


**Figure B-2 Box Plot of CPI for Complete Data Set**

2. Wilk-Shapiro evaluation of normality at each level

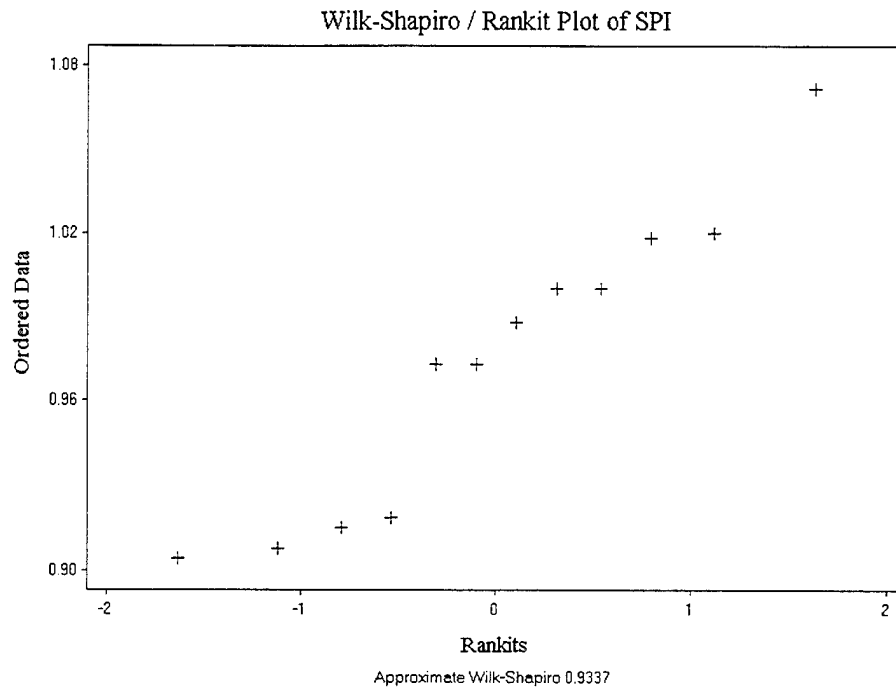


**Figure B-3 Wilk-Shapiro Plot for SPI at Rating Level One for Complete Data Set**

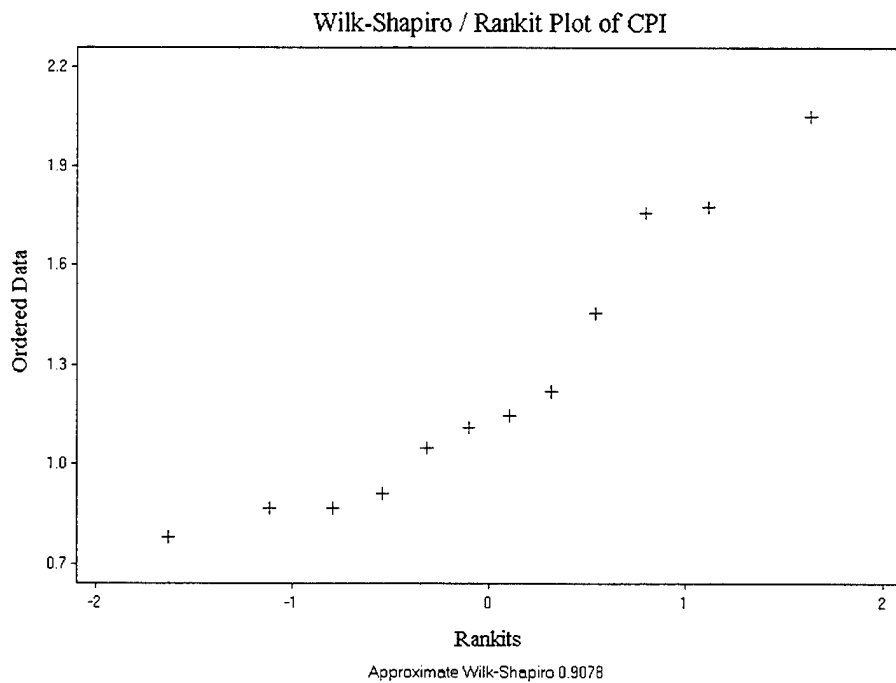


**Figure B-4 Wilk-Shapiro Plot for CPI at Rating Level One for Complete Data Set**

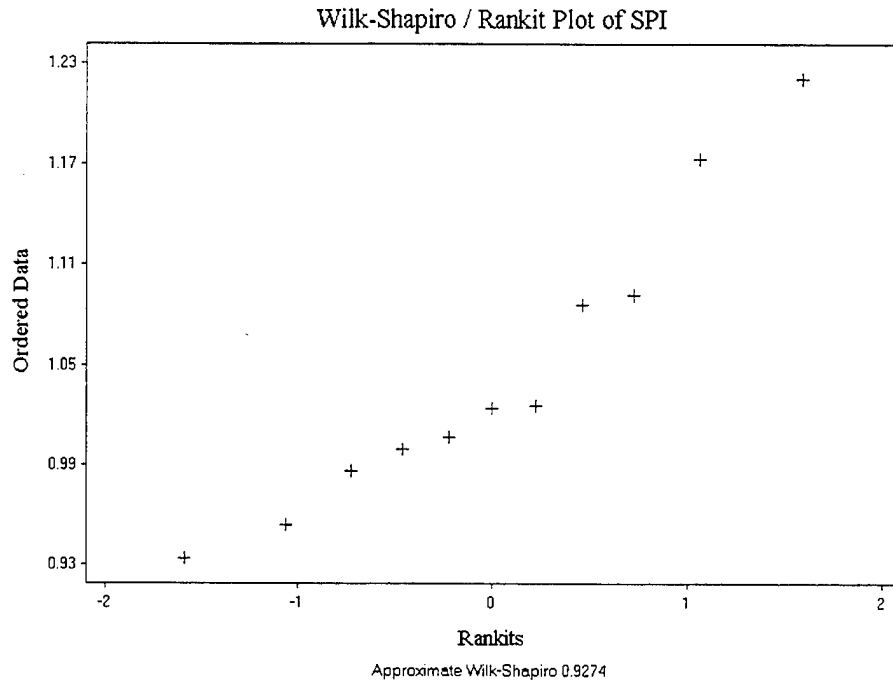




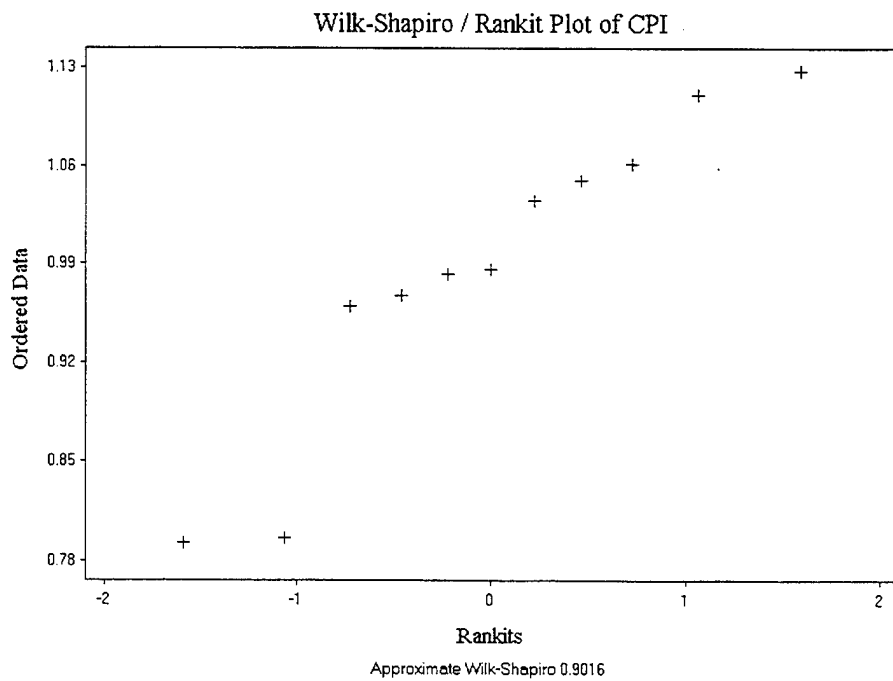
**Figure B-5 Wilk-Shapiro Plot of SPI at Rating Level 2 for Complete Data Set**



**Figure B-6 Wilk-Shapiro Plot of CPI at Rating Level 2 for Complete Data Set**



**Figure B-7 Wilk-Shapiro Plot of SPI at Rating Level 3 for Complete Data Set**



**Figure B-8 Wilk-Shapiro Plot of CPI at Rating Level 3 for Complete Data Set**

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## Vita

Lieutenant Schaefer was born in Richmond Heights, Ohio, on 25 July 1967. He attended Eastlake North High School in Eastlake, Ohio, graduating in 1985. After high school, Lieutenant Schaefer attended Cleveland State University in Cleveland, Ohio. While pursuing an undergraduate degree in computer engineering, Lieutenant Schaefer worked for Reliance Electric in the software research and development department as part of the cooperative education program.

While still an undergraduate, Lieutenant Schaefer enlisted in the Air Force on 25 May 1989. After finishing basic training at Lackland Air Force Base, Texas, and technical school at Keesler Air Force Base, Mississippi, he was assigned to the 38<sup>th</sup> tactical reconnaissance wing, 26<sup>th</sup> aircraft generation squadron Zweibruecken, Germany as a Guidance and Control Systems Specialist for the RF-4C aircraft. After closure of the base, Lieutenant Schaefer was assigned to Charleston Air Force Base, Charleston, South Carolina to work on the C-141 aircraft.

While there, Lieutenant Schaefer separated from the Air Force to join the Air Force Reserve Officer Training Corp. at Charleston Southern University. Upon graduation from Charleston Southern with a Bachelors of Technology in Computer Science/Mathematics, Lieutenant Schaefer received his commission on 21 May 1994. Upon commissioning, Lieutenant Schaefer was assigned to the Developmental Programming Office at Los Angeles Air Force Base, Los Angeles, California. While

there, Lieutenant Schaefer was selected to attend the Air Force Institute of Technology in May 1996.

Lieutenant Schaefer is married to his wife of six years, Alexandra and they are currently expecting their first child.

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**5. FUNDING NUMBERS****6. AUTHOR(S)**

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Current methods for monitoring the performance of Department of Defense (DOD) software development contractors have not been successful in reversing the current trend of over budget and behind schedule software development. The DOD has adopted the Software Engineering Institute's (SEI's) Capability Maturity Model (CMM) as a method of determining the process maturity of a software developer with the idea that a more mature process will lead to improved cost and schedule performance. The goal of this research was to determine if a model based on the CMM rating level of a contractor could be developed and used in conjunction with statistical process control to determine if contractor performance was progressing in a satisfactory manner.

To investigate this possibility descriptive statistics were applied to historical contractor performance data and a model was established. A different set of historical data was then used to evaluate the performance of the new model. This performance was then compared to the performance of current methods of statistical control. The results obtained in this research suggest that using the CMM rating level of a contractor to set statistical control bounds is as good, and perhaps better than, the current method being employed.

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